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Volume 32 **Number 7**

FEATURES

General Aviation Policy Statement 1
Pilot Decision Making, Part Four 2
Flight Standards Service, Part One 4
Flying Safely at Night. 8
Three Hundred Moving Parts. 11
Unusual Attitudes. 12
Why a Dual Ignition System?. 15
GPS 18
Will It or Won't It Quit 22
Test Your Piloting IQ . . . . . *Inside Back Cover*

DEPARTMENTS

In the HANGAR 3
FamousFLIGHTS 20
FlightFORUM 25
Airspace Corner 25
Instrument Corner. 26
AvNEWS/BRIEFS 27

Front Cover: *This United Express* DeHavilland Dash 8 *was on a training flight as part of the air carrier's certification program for operating the* Dash 8. *See page 4 to see how FAA is involved. Photo by Dean Chamberlain*

Back Cover: *How current is your night flying? See page 8.*

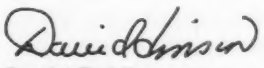
GENERAL AVIATION POLICY STATEMENT

General aviation is critically important to the Nation's economy and to the national transportation system. General aviation plays a crucial role in flight training for all segments of aviation and provides unique personal and recreational opportunities. It makes vital contributions to activities ranging from business aviation, to agricultural operations, to Warbird preservation, to glider and balloon flights.

ACCORDINGLY, IT IS THE POLICY OF THE FAA to foster and promote general aviation while continuing to improve its safety record. These goals are neither contradictory nor separable. They are best achieved by cooperating with the aviation community to define mutual concerns and joint efforts to accomplish objectives. We will strive to achieve the goals through voluntary compliance and methods designed to reduce the regulatory burden on general aviation.

The FAA's general aviation programs will focus on:

1. **SAFETY**
   To protect recent gains and aim for a new threshold.
2. **FAA SERVICES**
   To provide the general aviation community with responsive, customer-driven certification, air traffic, and other services.
3. **PRODUCT INNOVATION AND COMPETITIVENESS**
   To ensure the technological advancement of general aviation.
4. **SYSTEM ACCESS AND CAPACITY**
   To maximize general aviation's ability to operate in the National Airspace System.
5. **AFFORDABILITY**
   To promote economic and efficient general aviation operations, expand participation, and stimulate industry growth.



David R. Hinson
Administrator

September 8, 1993

Piper Aircraft Corp.

Pilot Decision Making

by Tom Hamilton

Risk and Crew Management

This is Part Four of a seven-part series that first appeared in Balloon Life *magazine and was originally written for balloon pilots. For the most part, we have left the lighter-than-air examples in because the overlying issue of pilot decision making affects all pilots, and the excellent information in these articles can be extrapolated to aviation activities other than ballooning.* ***—Editor***

In this issue in our continuing look at pilot decision-making, we will review the elements of risk in flying and examine risk assessment. Part 1 of this series looked at the four elements of risk that are involved in a *situation*: the pilot, the aircraft, the environment, and the type of operation.

Risk Assessment

As pilots, when we evaluate flying risks, we must first recognize a developing or potential hazard situation, analyze the situation, and finally resolve what action should be taken. In risk assessment the pilot reviews the elements (pilot, aircraft, environment, and operation), determines the risk associated with each, and evaluates the situation to determine what action is necessary.

And because a situation does not remain static, but changes continually, a pilot must constantly reevaluate the situation and its probable influence on the safe outcome of the flight.

Here is a brief review of the elements of the four risk factors:

Pilot: experience, competency, health, fatigue, attitude

Aircraft: airworthiness, type, size, accessories, fuel capacity

Environment: weather, airspace, topography, departure and arrival airports

Operation: for fun, for hire, day, night, heavy or light load, instruction

The question the pilot faces is, "How do I evaluate this risk?"

You might start by asking yourself, "What is the probability that if I do not do a fuel capacity check before takeoff that I will have enough to finish the flight?" Or, "If I don't use a checklist what is the probability that I will have to land in an area that might not be considered appropriate?"

By asking questions of this type and determining a probability of risk, you begin to establish the amount of risk that you are willing to take as a pilot. After you have accumulated several of these risk assumptions, the next question you can ask yourself is, "Is this amount of risk acceptable?"

What we have started to do here is establish some thoughts about our attitudes toward risk and what would be acceptable parameters under which you would make or continue a flight. By reviewing these various risk factors the pilot is able to arrive at a more informed decision.

A Practical Exercise

A technique that has been used at safety seminars is to pass out file cards in four different colors, one for each element described above. Half the participants indicate what they think would be a good example of each element on a different color card and the other half indicate what they think would be a bad example of each element. The cards are then grouped by color, shuffled, and then placed in four stacks. By drawing one card from each stack you have created a situation with four elements of risk defined. Now, what is your decision—to make the flight or not?

You will find some of the situations clear cut go or no/go. But, what about the grey areas? Should the flight be made or continued? Why?

Getting together with other pilots and conducting these types of exercises will provide practice in making decisions. The discussions that follow each decision will allow the group to explore additional items, methods of dealing with the situation, and build the participants' reference base for future decision-making. The goal here is to stimulate thinking about decision-making and risk assessment.

The effects of change and its probable influence on the safe outcome of a flight must be continually evaluated. An assessment of the risks created by that change helps to focus on those alternatives which are realistic and which will produce a safe outcome. By conducting these exercises, a projection of the events that are likely to flow from each

possible alternative to a situation, hopefully, results in a realistic approach.

As the pilot you have the capability and responsibility for determining the risks associated with a particular flight. Accident statistics indicate that 80–85% of all general aviation accidents involve "pilot error." Thinking about what might happen and planning for it helps the pilot to use superior knowledge to avoid situations that might require use of superior skill.

Crew Management

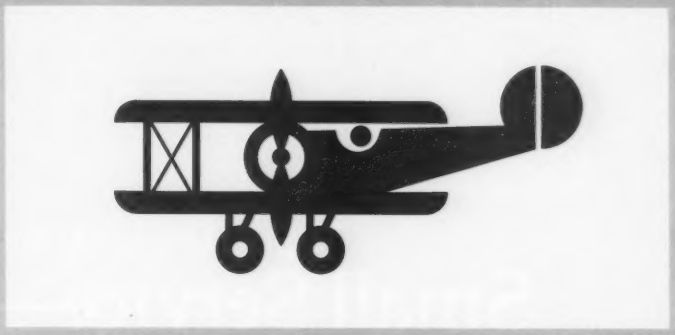
Crew resource management is the method of making the best use of all crew members (when others are present) through proper communication and coordination techniques.

Utilization of crew begins in the preflight phase of operation and continues through the inflation [or takeoff in an airplane—*Editor*], flight, landing, and recovery phases. How you utilize these people and communicate with them is an important element in conducting a safe flight.

A good place to start is by making a checklist of all the activities that you went your crew to participate in, what you want them to do or accomplish, and how you intend to communicate with them whether it is on the ground or in the air.

Involving the crew in this process will help to stimulate ideas on how to best accomplish various tasks and allows them to participate in the process and become an integral member of the team. ■

Answers to Quiz: 1–N, 2–M, 3–L, 4–K, 5–J, 6–I, 7–H, 8–G, 9–F, 10–E, 11–D, 12–C, 13–B, 14–A



Controller Is Dismayed When Student Obeys

The following incident actually happened to an FAA controller at a busy airport where a great deal of pilot training is conducted.

The traffic pattern had several trainers conducting "touch-and-go" landings. Several newly soloed students were in the landing sequence. Two of the students had been sequenced *number one* and *number two* for the runway.

The student *number one* ground-looped after landing and came to rest squarely in the middle of the runway. The controller immediately transmitted to student *number two*, who had already been cleared for a touch and go, "Go around! Disabled aircraft on the runway."

Student *number two* dutifully "rogered." The alert tower operator noticed , however, that student *number two* was continuing his approach. He repeated his previous transmission with a firmer voice, "Go around! Disabled aircraft on the runway."

Again, student *number two* obediently and quickly "rogered." But the tower man was something less than reassured when he noticed that student *number two* was about to cross the runway threshold, still in a landing attitude.

Student *number two* landed, taxied slowly around his companion's disabled aircraft, and then took off while the tower controller looked on in stunned silence.

On reflection, the tower controller realized that the student had complied to the letter with his instructions. He had landed, *taxied around the disabled aircraft on the runway*—and then took off again.

This article originally appeared in the June 26, 1967, issue of FAA Horizons, *the long-time defunct FAA employee publication. Our thanks to our Alaska Region for bringing it to our attention.*

If anyone would like to share a story with our readers, send it to us. Our budget precludes payment but we can give you a byline.

Dean Chamberlain

Fight Standards Service

Small Service—Big Job

by Dean Chamberlain, *Associate Editor*

Aviation Safety Inspectors

Part One

Two past issues of *FAA Aviation News* discussed the important role Flight Standards Aviation Safety Inspectors (ASI) play in aviation safety by highlighting two of the many types of jobs inspectors do—issuing safety waivers and conducting the Accident Prevention Program.

These articles told only part of the Aviation Safety Inspector's job. There are many, other, important aviation services available from the ASI's at your local FSDO, services that protect you in the air as well as people on the ground. Public safety is one of the Flight Standards Service's most important responsibilities. This concern for public safety is one of the reasons for regulations concerning minimum safe altitudes, dropping of objects from aircraft, and airshow safety, among others.

Flight Standards Service

Within the FAA, the Flight Standards Service is a small service with only about 3,400 employees, but it is a Service with a big job. The name says it all. The "first name" tells what we do, i.e., Flight Standards sets the aviation standards for airman and aircraft operations in the United States and for American airmen and aircraft around the world. The "last name" is *Service.* Combine the two and you have an organization that *serves* the needs of U.S. airmen by setting safety standards in the United States that also serve as examples around the world.

Flight Standards, like other FAA organizations, has a national director, Mr. Thomas C. Accardi, and a headquarters staff at FAA Headquarters in Washington, DC, which is broadly organized into divisions based upon work function (Air Transportation, Aircraft Maintenance, Technical Programs, Field Programs, the Regulatory Support Division based in Oklahoma, and the General Aviation and Commercial Division—the titles are self-explanatory). Regional Flight Standards division managers, one at each of the FAA's nine regional offices, coordinate Flight Standards activities within their respective regions.

But many inspectors will say the "real" day-to-day Flight Standards' work of serving the aviation public is done in the 90 Flight Standards district offices around the country and the four overseas international field offices.

Flight Standards District Offices

As many airmen and operators know, their local FSDO is their primary Flight Standards office for all of their aviation concerns or, to paraphrase a common advertising term, it's your one-stop shopping center for all your aviation needs. Whether you are a new student pilot with a question about your certificate or you are a seasoned professional aviator wanting information about starting an air carrier or charter operation, your local FSDO is there to serve you. Its services are as close as your nearest telephone or FAX machine.

This article is also about one of the FSDO's most important public safety services that usually goes unnoticed by the public, and that is the safe departure and arrival of thousands of flights, both air carrier and general aviation, with their many passengers. This is also the story of the men and women who work in your local Flight Standards District Office and their efforts to both protect and serve you. (We'd like to call it, "A day in the life of a FSDO," but the editor doesn't like clichés.) We will highlight some of the typical work activities done by field inspectors and support specialists at a FSDO, and we will talk to a FSDO manager about how the public and FAA can work together for the benefit of all. By doing so, we hope to point out some of the ways your local FSDO can help make your aviation experience more enjoyable.

If you find the term "aviation experience" somewhat convoluted, it is. If you are wondering why we simply did not say "flying experience," the answer is simple. FSDO's serve all airmen—pilots, maintenance technicians, amateur-built aircraft builders, flight engineers, flight attendants, air carrier

executives, and all others as defined in the FAR as "airmen." Too many people only think of pilots when they think of aviation, but without the hard work, professionalism, and dedication of many others in the industry, pilots and aviation in general would never get off the ground.

We will also point out some ways for airmen to save time and effort in dealing with their local FSDO by emphasizing some of the common problems airmen have in dealing with the FAA.

The best way for all airmen to avoid being buried in needless bureaucratic paperwork, unnecessary corrections, and long delays is to learn what is required in order to simplify the approval process. By eliminating unnecessary extra work, everyone benefits.

A Typical FSDO

Much of this article is based upon the activities at the Washington Flight Standards District Office located at Dulles International Airport in northern Virginia. The Washington FSDO is fairly representative of FSDO's nationwide and the types of services each provides.

During an interview with the Washington FSDO Manager Kent D. Stephens about the services provided by the Washington FSDO and similar FSDO's he wanted to make one point very clear. "One of the popular misconceptions many airmen have about FAA aviation safety inspectors is that they are policemen or policewomen. That is not true. Flight Standards is a service organization that has a public trust for developing aviation standards for the public good. It is not a police force," he said.

According to Stephens the FAA depends upon the voluntary cooperation of all airmen in its efforts to fulfill its statutory role of promoting and regulating aviation, and the idea of inspectors being cops does not support that voluntary compliance attitude. Having said that, he was quick to point out that inspectors will take appropriate action to protect the public when pilots or operators fail to comply with appropriate regulations. "The key to aviation safety is the mutual respect and cooperation between FSDO inspectors and the airmen, aircraft owners, and operators they work with," Stephens said.

Inspector Tasks

According to Stephens, "Inspectors are responsible for accomplishing five tasks. They are required to do certification, surveillance, accident investigation, enforcement, and promotional work." Many of the tasks are self-explanatory. For example, certification deals with both individual airman and operators such as airlines, air taxis, and maintenance facilities. Surveillance means checking those same airmen and operators for compliance with appropriate regulations. Accident investigation involves both work on behalf of the FAA, and when requested by NTSB, on behalf of NTSB. The enforcement part of an inspector's job involves investigating incidents of alleged non-compliance of the FAR or FAA procedures. Promotional work involves supporting aviation growth and development as well as promoting public confidence in the world's safest aviation system through effective regulatory programs.

Air Carrier Certification And Safety

"If you ask the average passenger how his or her flight was, the typical answer will probably either be, 'It was bumpy,' or 'The airline lost my bag.' In a sense from a safety standpoint, neither relates to safety, but isn't it interesting when passengers talk about their flights, they discuss how smooth the flight was or the status of their bags? Seldom do they discuss how safe the flight was," Stephens said.

"No one truly sees what goes on in the background as far as crew training, people having to meet simulator requirements, hours and hours of review by both FAA and the company developing manuals and procedures for deicing, flight attendants, pilots, ground servicing personnel, proving flights, evacuation drills, and the hundreds, if not thousands of hours that go into certification. It really is praise for the FAA when someone is asked how his or her flight was, and all they can say is the air was a little bumpy or it took a while to get my bag. We know we have done our job at that point if that is the most significant activity that took place on that flight," he said.

Stephens provided another example of Flight Standards' dedication to service by using a recent air carrier certification process at his office. "At times, I counted 13 inspectors from this office involved in one manner or another in the certification of that airline," he said, "and that certification only involved a new aircraft, not a new airline."

Starting a new airline involves developing procedures, manuals, and operations specifications among other things. "There is no cookbook that tells someone how to start a new airline," he said.

"The process involves taking a lot of procedures and regulations and

Dean Chamberlain

Washington FSDO Manager Kent D. Stephens discusses FSDO procedures in his office.

compiling a list of related tasks that must be accomplished. Certification is designed for people who know what they are doing. It also requires certain experience requirements to be met by the key management individuals involved, and it requires a lot of money. It also involves a lot of time both by the company and the FAA. It is a massive amount of work. You would think with just one rule [FAR Part 121] for air carriers, certification would be easy, but that is not the case," he said.

For example simple questions such as, "How much training is needed for the pilots," or, "Who trains the first instructor," can become major questions that must be resolved during the certification process. Certification takes a lot of time, energy, and effort. The main task is to ensure that that airline's first flight is a safe one.

"Passengers may never realize all that went on in the background to get them there," Stephens said, "but, the purpose of all of that work is to get the passengers to their destination safely."

FSDO Organization

To serve the different aviation needs of airmen and operators within its area and to better use the experience of its inspectors, the Washington FSDO is organized into four primary sections. One is an administrative section to support the FSDO administrative needs. The other three are operational sections made up of inspectors based upon the type of work and parts of the FAR each group works with. The office manager, the administrative officer, the Accident Prevention Program Manager, a Cabin Safety Specialist (more about this unique position later), and administrative support personnel make up the administrative section. As the name implies, this section provides several important services.

The manager, besides providing the guidance for the office, also participates in the certification work done within the office. Many certification actions require the manager's or acting manager's signature. And like managers everywhere, the manager is responsible for the training and personnel actions for all of the assigned staff.

Assisting the manager in many of these activities, especially when dealing with Regional and FAA Headquarters' matters, is the administrative officer who is an expert in FAA administration policies and procedures. Supporting the administrative and operational functions of the office are the administrative support personnel. Without the secretarial, data entry, and clerical support provided by the support specialists, many of the functions done by the office would come to a screeching halt.

Another important part of the administrative team is the Accident Prevention Program Manager (APPM), whose duties were outlined in the article on the Accident Prevention Program in the November/December 1992 issue of *FAA Aviation News*.

The final person in the administrative section is the office's cabin safety specialist. One of only a handful of such specialists in the FAA, the Washington cabin safety specialist plays an important role in helping to protect passengers in commuter and air carrier operations by ensuring the air carriers comply with appropriate FAA cabin safety requirements. Together all of these people play a key role in the day to day operation of the FSDO.

Operations Unit

The remaining three sections within the office are identified by the type of work the assigned aviation safety inspectors do. As the name implies, the Operations Unit serves the operational needs of both airmen and operators based within the District. Some of the assigned "Ops" inspectors work with air carrier and scheduled commuter operators operating under FAR Parts 121 and 135, while other Ops inspectors work with general aviation operators and pilots operating under FAR Parts 135, 133, 137, 141, and 91. All Ops inspectors deal with FAR Part 61 matters. One Ops inspector at Washington FSDO is a specialist in air crew training and advanced simulation instruction and training.

Typical Ops inspector duties range from giving pilot certification check rides, to giving air carrier crew check rides, to going on air carrier or air taxi proving flights during which the pilot or crew must demonstrate their ability to safely fly the route and/or aircraft as part of a required certification program. Ops inspectors also work with flight schools and air carrier training facilities. Ops inspectors also get involved in many investigations. An important part of their job is answering questions about all aspects of pilot and air crew certification and aircraft operating procedures. For example, an Ops inspector can spend a significant amount of time working with a FAR Part 121 air carrier or Part 135 commuter or air taxi operator in developing operating specifications for the operation as part of the certification process. For those not familiar with the term "operational specifications," or as they're more commonly called "ops specs," ops specs define or limit the types of operation or under what conditions an operator can operate under FAR Parts 121 or 135. As you can see, like other inspectors within a FSDO, the duties of an Ops inspector are varied both in content and detail.

And like other inspectors, Ops inspectors have both a required training program they must complete as well as ongoing recurrent training. One of the constant challenges for all inspectors and FSDO managers is keeping up with the rapidly changing aviation industry which requires continued refocusing of the organization's energies.

Airworthiness Unit

The Airworthiness Unit, like the Operations Unit, is divided into specialties based upon the type of work performed. There are airworthiness (AW) inspectors who work primarily with FAR Part 121 air carrier operators and FAR Part 135 Scheduled Commuter operators while others work primarily with general aviation operators. The office's Avionics Inspector is part of the Airworthiness Unit at Washington.

Like their Ops inspector counterparts, airworthiness inspectors are involved in a wide-range of aviation community activities. In many cases they work as part of a FSDO team,

Dean Chamberlain

Richard F. Belle (left) a Supervisory Aviation Safety Inspector talks with United Express crewmembers following their flight at Dulles International Airport. Belle was monitoring the air carrier's operations as part of the air carrier's new aircraft certification program.

one or more Ops inspectors and one or more AW inspectors, on many certification or certification renewal projects. AW inspectors play a key role in the certification of air carriers, air taxis, flight schools, and maintenance shops. They take the lead in inspecting and certificating maintenance facilities and maintenance training facilities and schools. They are involved in the certification of airframe & powerplant (A&P) maintenance technicians and those A&P's with inspection authorization (IA's) within their areas as well as refresher clinics for IA's. And as explained in Part 2 of this series, AW inspectors are involved in certificating amateur-built aircraft and their builders. AW inspectors also play a critical role in accident and incident investigations.

Geographic Unit

A group of inspectors are assigned to the unique Geographic Unit. This unit contains both operations and airworthiness inspectors. They are responsible for ensuring that air carrier operators who use airports and facilities within the Washington FSDO's area, but whose main-base of operation is located in another FSDO's district, comply with appropriate regulations and procedures. Although, the certificate holding district office, the "home-based" FSDO, is responsible for servicing the needs of all of the operators based within its area and ensuring those operators are in compliance with appropriate FAR, Geographic inspectors work with the certificate-holding FSDO to ensure its operators are in compliance with regulations and approved procedures while they are flying into and through Washington FSDO's area of responsibility.

Geographic units also provide an important national service. They give Flight Standards the mechanism to monitor the operational safety of air carriers throughout the nation regardless of the location of their supervising FSDO or certificate holding office. Geographic units help provide the flying public a vital safety net by ensuring the same safety standard is applied throughout an air carrier's system.

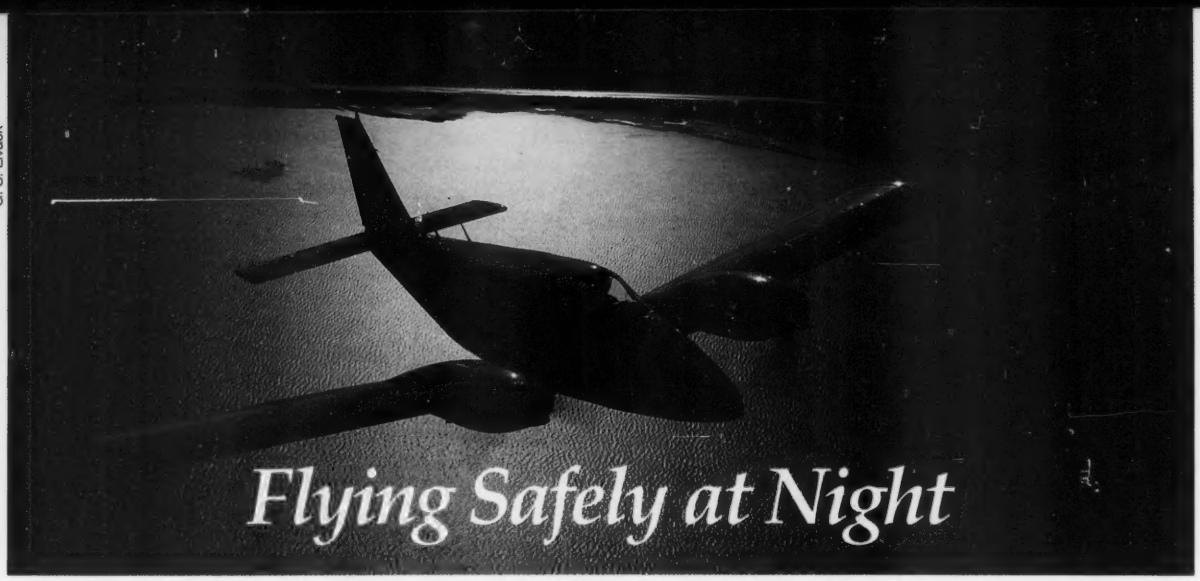
How to Help Yourself

Obviously, not everyone wants to start an airline or an air taxi operation, a flight school, etc., but for those who do, there are ways to speed up the application process. You could hire an aviation consultant or contract with a company to help you develop the necessary documents and training manuals. But one of the easiest ways is simply to call your local FSDO for an appointment to meet with an inspector specializing in your particular operation. The inspector will provide guidance in what has to be done and in many cases will provide you a list of references and instructions you must follow to start the application process.

For major projects such as starting an air taxi operation or a FAR Part 141 flight school, you might want to purchase copies of the appropriate FAA inspector manual or manuals that pertain to your intended operation. An inspector at your local FSDO can tell you what documents you might be interested in. The various inspector handbooks will show you what items an inspector must look at and approve for any operation. The handbooks also show examples of how to fill out the required FAA forms correctly for each specific application. Copies of the various inspector handbooks can be ordered from the U.S. Government Printing Office (GPO) in either Washington, DC, or from select GPO bookstores in some major cities. In addition, the FAA publishes Advisory Circulars on many procedures that outline many application processes. Also, many trade organizations produce "how to guides" on significant FAA application processes. Knowing what is expected is one way to help yourself during any certification process. Another way is by completing all applications properly. Many applicants fail to complete their various application forms properly. Missing information not only delays the processing of the form and adds to the amount of time an airman must wait for his or her certificate, it also adds to the workload of the inspector trying to get the application corrected. The time and effort spent on the telephone discussing the status of the application and in trying to correct the incomplete application is like a snowball rolling down hill. And no one likes to get buried in an avalanche of paperwork or delays, especially an inspector or an airman waiting for his or her certificate.

Another way of learning how to work with the FAA and its inspectors is by understanding how a typical FSDO is organized and the job requirements of the various types of inspectors assigned at a typical FSDO. ■

Part 2 of this article in the FAA Aviation News *will present a "typical" day in the life of an inspector. During that "day" we will tell you how to prepare yourself for a check ride, show some of the steps in air carrier certification including cabin safety, discuss the "bogus" parts issue, and explain how amateur-built aircraft are certificated among other things. For those interested in becoming an FAA aviation safety inspector, we will list some of the job requirements and briefly outline how to apply for a job with the FAA.*



G. S. Livack

Flying Safely at Night

by Thomas N. Jones, *APPM, Winston-Salem, NC FSDO*

My first inclination was to title this article "Night Flight," but that title was taken long ago by a pioneer aviation writer, Antoine De Saint-Exupery. His book was a largely romanticized account of flying mail planes at night using very primitive navigational facilities.

What I want to do is more practical than romantic: To acquaint the pilot with precautions to take while flying at night or to refresh the pilot's knowledge of aircraft operations at night. In order to use your aircraft fully and get the most out of all the bucks you put into it, there will be times when it may be necessary to fly in less than ideal conditions. When appropriately current and qualified, we may have to fly in instrument meteorological conditions (IMC) or at night or both.

In night flight, as in all flight operations, there are several distinct components that are required for safe flight. Individually identified they are:

- **The Pilot**
- **The Aircraft**
- **Useful Equipment**
- **The Atmospheric Environment** *(i.e., weather)*
- **Airport Facilities.**

The Pilot

First, let's look at pilots, you and me. Of course, to fly at night, you can't have a night flying restriction on your certificate. Furthermore, to be pilot in command while carrying passengers at night, you have to have had three takeoffs and three landings at night to a full stop in category and class within the preceding 90 days.

Currency and qualification aside, one thing that is absolutely essential to be a pilot is vision. We may be able to fly an aircraft with many illnesses that would disqualify us to pass an FAA medical examination, but without vision it is physically impossible—at least as I'm writing this it is.

It is important for pilots to have a good understanding of how the vision system works. (Just like airplanes, we pilots have systems also!) Nearly everything we do and many ailments, illnesses, etc., affect our vision. A rule of thumb would be anything that reduces the amount of oxygen going to the eye will have a detrimental effect on vision.

Consequently, smoking is detrimental to vision for several reasons:

1. Smoke obscures vision.
2. Carbon monoxide (CO), a by-product of smoke, combines with the oxygen-carrying red corpuscles of the blood approximately 200 times greater than oxygen, thus displacing oxygen in the bloodstream and decreasing the amount of oxygen to the eyes.
3. Smoking nicotine constricts the blood vessels, allowing less blood and less oxygen to reach the eyes.

Our eyes see when light entering the pupil strikes the retina, the light sensitive layer of tissue at the back of the eye that is analogous to the film in a camera. The retina contains two kinds of light sensitive receptor cells—rods and cones. The cones are responsible for daytime and color vision. Rods are responsible for vision in dim light.

The central region of the human eye (the fovea), on which we depend most for vision, is tightly packed with cones but contains no rods. The rest of the human retina contains both rods and cones, and the ratio of rods to cones increases in the periphery of the human retina. Could this be one of the reasons that we can see things better at night or in dim light in our peripheral vision?

As winter approaches the days get shorter, and the hours of darkness increase. Consequently, we need to be aware of how the environment affects our vision. For example, winter is the time for respiratory illnesses—colds, flu, allergies—to be more prevalent. Most of us treat our symptoms of these maladies with the many medications that can be purchased "over the counter." *No pilot acting as a "required crewmember" should ever use a medication that has not been approved by an aviation medical examiner (AME).*

Why not? The obvious reasons such as inducing nervousness or sleepiness aside, one of the many reasons is the possibility of histotoxic hypoxia. This is a condition in which certain chemicals

inhibit the cells of the body to assimilate oxygen. No matter how much supplemental oxygen is used, the body cannot absorb it. Alcohol is one of the offending chemicals that causes histotoxic hypoxia. The FAA Office of Aviation Medicine recently published a brochure containing a chart that shows some of the symptoms associated with the use of "over the counter" medication. (The January/February 1993 issue of *FAA Aviation News* reprinted the information in that brochure, including the chart.) If you are taking ANY medication, obtain approval from your AME. Your family physician may not be familiar with the problems associated with using a certain drug and flying an aircraft. AME's receive special training in this area.

Winter also brings on colder weather. In many cases the aircraft is heated by air blown directly off the aircraft exhaust system. If there are any leaks in this system, carbon monoxide will be introduced directly into the aircraft and, thus, directly into the pilot. This can and does cause unconsciousness and ultimately death. Symptoms of carbon monoxide poisoning include headache, drowsiness, or dizziness. Carbon monoxide is odorless, but because it is mixed with exhaust fumes, a smell of exhaust in the cockpit could mean CO is present.

Some of the ways to deal with suspected carbon monoxide poisoning are to use supplemental oxygen, breathe outside air, close heating vents, and land as soon as possible. Do not expect to recover from CO poisoning for a while. It takes time for the bloodstream to become saturated with oxygen again. A CO detector in the aircraft cabin is a good investment.

The Aircraft

Of course the aircraft must have an electrical system for night flight. One necessary question before your night flight is, "How healthy is the electrical system on the aircraft that you propose to fly at night?" Is the alternator/generator in good repair? How about electrical connections, drive belts, battery condition, etc.? An ounce of prevention is truly worth a pound of cure! (In the event of a discharged battery, a common problem in the winter time, the use of an automotive-type battery charger is not recommended. If the battery is charged improperly, it may deteriorate more rapidly than if properly charged. An excessive charge rate is also not recommended; it may cause the battery to explode.)

Good maintenance procedures and an extra careful pre-flight inspection are essential for safe flying at any time, and ESPECIALLY in the dark! Be sure all the lights—inside and out—work. Landing lights are very often used during daylight hours to increase visibility for collision avoidance and may be burned out. A spare bulb or two might be a good investment!

If you routinely fly above 5,000' MSL at night, supplemental oxygen could be a wise investment. A few minutes on pure oxygen will do wonders! For improved night vision, corporate and airline pilots routinely use supplemental oxygen before making an approach at night. I have found that after a long flight at night if I use supplemental oxygen before an approach, lights appear to grow brighter—just as though I turned up a rheostat! It is especially important when fatigued to use supplemental oxygen. Hypoxia again! Of course any oxygen system installed in the aircraft must have routine maintenance as well as the rest of the aircraft systems. Follow manufacturer's recommendations for carry-on systems.

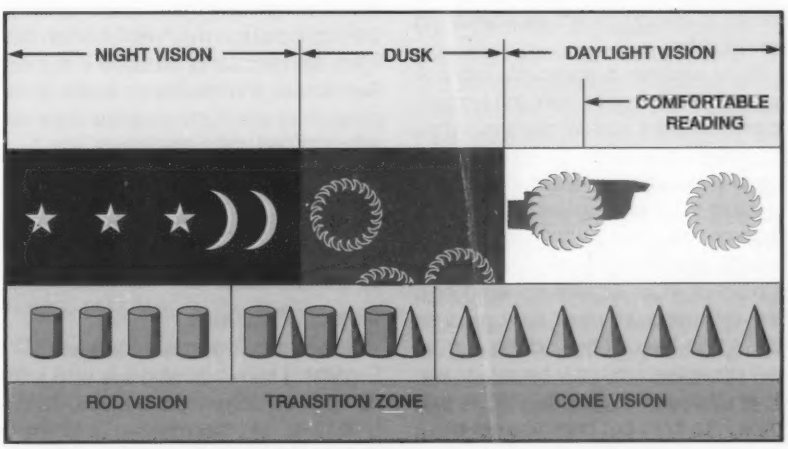
Useful Equipment

Some of the items that should be included in the pilot's equipment for a night flight are flashlights; spare batteries and bulbs for the flashlights; current charts; airport diagrams with taxi charts; a CO detector; blankets, etc.

For example, carry at least one flashlight, but remember, flashlights break, bulbs burn out, batteries discharge. Spare flashlights, bulbs, and batteries are not that expensive. The disastrous effects of an electrical failure at night will be greatly diminished by having emergency lights. Pre- and post-flight procedures are greatly enhanced with light—it is very difficult to check the oil and fuel levels and look for contaminants in the dark!

There are other light sources that can be used in emergencies. Light sticks that glow in the dark are good for a one time use, and their use could save flashlight batteries while enroute and leave the flashlight for use later during the approach. Pilots have come up with some innovative ways of holding a flashlight when they only have two hands—one flying the airplane and one holding a chart or tuning a radio. Between the teeth or under the chin are the most popular places. But flashlights that have a cord attached to one end to hang around the neck or ones with flexible necks and that clip to your clothes are now available.

Another form of "equipment" is having the proper publications available.



The retina contains two kinds of light sensitive receptor cells—rods and cones.

Current sectional charts are important because they show altitudes of obstructions and the location of airports and roads. Having a "road map" of the airport taxiways and runways is very helpful. Airport taxi charts are contained in NOS and Jeppesen approach charts. There are also other publications with airport diagrams. The *Airport Facility Directory* has a veritable wealth of information about airports, ATC frequencies, etc. The *Airman's Information Manual* is an excellent resource. An explanation of airport lighting and a section on flight physiology is contained in this very important publication.

A blanket may also be an important item to have along. With the cooler temperatures at night, passenger comfort is a very important ingredient to a successful flight. It would also be good to have along in the event of a precautionary landing off airport or at an airport with no facilities.

The Atmospheric Environment—Weather!

"Everybody talks about the weather, but no one does anything about it!" is an old saying that holds true today. With all of our technology, satellites, radar, meteorologists with PhD's, we still cannot tell with a great degree of accuracy what the weather is going to do. We use all the weather information sources available to us, then make an educated choice based on what we learn from the weather services. Our experience level, our equipment, and our preparation are large determining factors in whether or not we operate an aircraft safely.

Night weather is especially tricky. A big problem is fog. At night the temperature/dew point spread narrows. When the spread is less than 5°, some type of fog is likely. The dew point is the temperature to which air must be cooled to become saturated by the water vapor already present in the air. A dew point spread of 4° or 5° with no wind or a very light wind will most likely produce fog. A thin layer of ground fog can be very deceptive. You may be able to see down through it and think it is thin enough to fly in, but once you get into it all visibility could very well be lost.

Study Guides for Night Flying

- *Airman's Information Manual*
- *Airport/Facility Directory*
- AC–61–23B, Pilot's Handbook of Aeronautical Knowledge
- AC–006A, Aviation Weather
- AC–0045C, Aviation Weather Services
- AC–70/7460–1H, Obstruction Marking and Lighting
- AC–67–2, Medical Handbook for Pilots

Other safety pamphlets are available at your local FSDO. See your Accident Prevention Program Manager (APPM) for free information dealing with Safety of Flight and participate in the Pilot Proficiency Award Program (WINGS).

Clouds are also difficult to see and avoid at night. A good idea is to be sure the ceiling and visibility are adequate if planning VFR flight. Another is to attend an Accident Prevention Program seminar dealing with disorientation and take a ride in the "Barony Chair." Learn about vertigo. Some recurrent instrument training could be an excellent precaution, *especially* some training on "partial panel." Knowing how to make a 180° turn solely by reference to instruments is one of the most important skills a pilot can possess.

While flying at night, if you see the lights on the ground start to "twinkle," landing at the nearest suitable airport may be called for. Fog forms rapidly in the cool night air. When it starts to form, the first indication may well be when the lights are diffused by moisture in the air. Remember, the dew point is the temperature at which the moisture in the air will most likely become visible.

With all the limitations of the weather forecasts, a good weather briefing, and an *understanding* of the briefing is essential to safe flight. It is also required by FAR § 91.103!

Airport Facilities

Airports come in a wide variety—Everything from a small grass strip with no lights to behemoths like JFK, DFW, LAX, ORD, etc. Approaches to different airports require different skills. An approach to an airport with a VASI, a glide slope, REILS, sequential discharging lights, centerline lights, green lights in the center of taxiways, etc., is far different from a "black hole" approach to a barely lighted runway in a sparsely populated area with obstructions all around.

General aviation pilots routinely operate at airports with minimal facilities. How do we maximize resources at such airports? One way is to learn how to make a stabilized, steep approach. Practice this first during the day. Try to visit more remote and "primitive" airports during daylight hours before attempting an approach at night. Look up the airport in the Airport/Facility Directory to determine what lighting aids may be available. Many of the smaller airports have pilot controlled lighting. Learn how to activate the runway lights from the airport's entry in the Airman's Information Manual (AIM).

You might also contact the airport operator before attempting a flight into a strange airport at night. (This might be a good idea in daylight also!) If you know someone who has an airplane based there, call them and ask about special procedures. You can also call the nearest FSDO, talk to the APPM, and find out if there is an Accident Prevention Counselor at that airport who may be able to give you hints on how to approach and land safely at night.

While on approach to an airport at night be particularly observant of the runway lights. If they start to "blink," "twinkle," or appear to "flash" near the end of the runway—GO AROUND! More than likely what you are seeing is some kind of obstruction between you and the runway, i.e., trees, powerlines, fences, etc. Remember one of the basic laws of physics: "No two objects can occupy the same space at the same time!"

When flying anytime, but especially at night, use every resource you can think of. The more information you have, the more skills you acquire, the better your equipment, all these increase your chances of having a safe successful flight.

Remember the five P's:
Proper Preparation Prevents Poor Performance! ■

Three Hundred Moving Parts

by Ivan J. Jaffe

"You fly one of those things!? Three hundred moving part waiting for something to go wrong, and then you fall like a brick."

If I've heard this once about helicopters, I've heard it a thousand times. Not from an uninformed, clueless wannabee pilot, but from experienced and knowledgeable fixed-wing captains. The helicopter, for this vocal observer, may as well be a Martian flying saucer, using extraterrestrial aerodynamics to stay in the air, precariously on the edge of obliteration at the slightest hiccup.

Not so, of course. The helicopter is a safe efficient flying machine with the unique capacity of flying without moving over the ground—an advantage that opens innumerable opportunities of access and ability in countless facets of life, such as sightseeing and photography, movie making, and air ambulence services.

So why such comments from people who should know better? The truth about helicopters and the good that they do has too often taken a back seat to the sensational publicity of the daring low-level antics and ensuing helicopter crash so often depicted in today's entertainment media. This is an image we in the helicopter industry are not entirely blameless of because of our deficiency in disseminating the real facts about our machines and our pilots.

Clearly, this false view of the helicopter is not limited to the general, non-flying public but rather, it seems, to almost everyone outside of helicopter pilots. We are beginning to understand our distorted image as viewed from the cockpit of the airplane, and I would like to highlight some of the misunderstandings surrounding our flying machines.

"Where is That Crazy Eggbeater!"

A common problem is that we are not easy to spot from the airplane cockpit, especially in the traffic pattern. We're small, slow, low, and often below the horizon, not following conventional traffic patterns, contending with wings and instrument panels obstructing view and, in fact, do not even look like an "aircraft."

Conversely, the visibility from a helicopter cockpit, windshield cleanliness and sun position notwithstanding, is excellent, and spotting traffic is usually not a problem for us. This, coupled with our ability to slow down or even stop, keeps us well away from potential collision areas.

If you're looking for a helicopter in the traffic pattern, we will usually be flying unconventional patterns, i.e., right side and approximately 800 feet AGL. Our approaches will usually be to a point other than the runway—often a helipad or taxiway on the airport.

"When that Engine Fails, the Fan Stops, and You Really Begin to Sweat!"

Have you ever heard of "autorotation?" Do you know what autorotation is? No? Well, it is simply a glide in a helicopter. Yes, we can glide, and in fact we can do even better than that. We can terminate the autorotation (remember, no engine) in a safe landing in the space of 20 feet or less, very often in a hover landing! Very different flying characteristics from a brick. We offer far more safe forced landing opportunities than even a Cessna 152. Next time you're on a cross-country flight, note how many 20–foot clearances you can see along your route.

"Helicopter N1234, Hold Your Position on Final for One Departure"

What a great aircraft we fly; we can stop in midair and wait. A Controller's dream! Did you know, however, that a successful autorotation for many helicopters is impossible if it is initiated from the hover anywhere between 20 and 400 feet AGL? Helicopters can and are often required to operate in the hover within this envelope. However, for engine failure considerations, we would prefer to have some airspeed below approximately 400 feet AGL. Today's advanced engine reliability statistics allow safer flight in these areas, but you can be assured that the helicopter pilot hovering below 400 feet AGL has thoroughly assessed and is constantly monitoring the engine's operations and is well aware of the options he or she has in the event of an emergency.

Continued on page 14

Unusual Attitudes: Helicopters and Instrument Flight

by Hillman E. Bearden

While attempting to remain under visual flight rules (VFR) in marginal weather conditions, an instrument-rated pilot flying an instrument-equipped helicopter crashes into a hillside. There are no survivors.

Within a month a similar accident occurs. This time the aircraft collides with a power line. Aviation statistics show that this deadly scenario continues to occur with tragic frequency. Despite training and awareness programs, pilots operating legally under VFR continue to collide with obstructions or terrain because poor visibility prevents avoidance or because inadvertent instrument meteorological conditions (IMC) induce spatial disorientation from which the pilot cannot recover in sufficient time to regain aircraft control.

There are many reasons why a pilot on a VFR flight will continue flying into deteriorating weather conditions while depending on visual references to navigate and maintain aircraft control. Some of these reasons are practical in nature while others are personal and vary among pilots.

Options Have Advantages and Disadvantages

The only other options to continuing the flight under VFR are landing in a suitable open area or climbing into IMC. These options are often dismissed because both require a major change in the original flight plan and create complications that the pilot has little time to contemplate fully. Having to plan a new course of action completely would require the pilot to dilute his or her concentration with matters other than safely flying the aircraft. An in-flight mission change is no small task—even when everything is going well.

The option of landing short of the destination runs counter to the pilot's purpose for flying in the first place. The importance of the flight has already been established before takeoff, and the pilot has the intention of completing the flight. External pressures, from passengers or others involved in the operation, add to the pilot's own internal pressure to complete the flight with as little direction as possible.

The second, and [perhaps] least desirable, option requires transitioning to instruments and continuing under instrument flight rules (IFR) without adequate preparation. Even a pilot proficient in instrument procedures is at a serious disadvantage when confronted with the prospect of climbing into instrument conditions when no planning for an IFR operations has been made.

Mission Compatibility

For most helicopter pilots, instrument flights are not compatible with their missions and, although they may be required by their employers to possess instrument ratings, they may not have had the opportunity (or been required) to maintain instrument competency. Therefore, a pilot may not be inclined to venture into an IFR environment because of a lack of confidence in his or her ability to control the aircraft adequately by reference to instruments. The pilot would, at the same time, have the tasks of navigating to an airfield for an instrument letdown to visual conditions and communication with ATC to allow for proper separation from other aircraft.

Ego and Go/No-Go Decisions

Ego can also influence go/no-go decisions. The pilot elected to take off when the weather conditions were supposedly forecast and known. Could the pilot be considered guilty of poor judgement if flight under VFR could not be continued? It may be that the pilot had gotten through bad weather many times before. Would landing short of the destination make it appear that the pilot was frightened or lost or lacking in pilot skills?

A natural conclusion is that good judgement was used when the decision was made to take off and that the flight can somehow be completed. Any other conclusion might threaten to undermine the self confidence all pilots must have in order to compete in their chosen profession. Still, objective self-evaluation is imperative when facts

begin to suggest that potentially dangerous pilot attitudes are at work.

Aeronautical Decision Making

An FAA publication, *Aeronautical Decision Making for Helicopter Pilots*, concluded:

> "Pilots, particularly those with considerable experience, as a rule try to complete a flight as planned, please passengers, meet schedules, and generally demonstrate the 'right stuff.' [But] this basic drive can have an adverse effect [sic] on safety and impose an unrealistic assessment of piloting skills under stressful conditions. Even worse, these repetitive patterns of behavior, based on unrealistic assessments, produce piloting practices that are dangerous, often illegal, and will ultimately lead to mishaps."

Aircraft accidents cannot simply be accepted as the cost of doing business. While accident prevention can be expensive in terms of dollars lost when flights are cancelled because of weather and [in terms of] the cost of recurrent training for pilots, it is worth the price when it prevents loss of life and aircraft.

Another FAA publication, *Aeronautical Decision Making for Air Ambulance Helicopter Pilots: Situational Awareness Exercises*, said weather-related accidents involving low visibility or spatial disorientation are the most serious and easily prevented types of accidents. The publication, which focused on accidents involving helicopters on emergency medical missions, said that 67% of all fatal aeromedical accidents were weather-related.

> "The vast majority (71%) of these [accidents] occur during the hours of darkness and during the en route segment of flight."
>
> [The report] said that 40% of all emergency medical flight operations are at night. [The] study concluded:
>
> "Pilots either are not being adequately trained, are forgetting their training or are not maintaining their proficiency in those special skills and knowledge demanded by flying in the dark. The prudent aeromedical pilot must be proficient in keeping the helicopter upright by reference to instruments, even if he [or she] is not instrument rated."

The studies also conclude that weather-related accidents involving low visibility and spatial disorientation are among the most serious and easily preventable kinds of accidents in other less specialized kinds of helicopter operations.

Reasonable minimums for VFR operations can reduce but not eliminate the risk of encountering inadvertent IMC. Recurrent instrument training can greatly improve a pilot's ability to avoid unsafe situations or safely recover from IMC that cannot be avoided.

Risk Assessment, Pilot Judgement, and Weather

Accurate risk assessment and pilot judgement also play key roles. The FAA study said,

> "One bad decision often leads to another (in the decision chain). One poor decision, e.g., inaccurate assessment of deteriorating weather, increases the availability of false information that may then negatively influence decisions that follow. As time progresses, the alternatives available may decrease, and the option to select the remaining alternatives may be lost. For example, if a pilot elects to fly into hazardous weather, the alternative to circumnavigate the weather is automatically lost."

Considering the difficulty of accurately forecasting precise weather conditions, especially in areas remote from weather observing stations, it is likely that pilots flying in those areas will sometimes encounter reduced ceilings and visibilities, although the forecast is generally favorable for VFR flight. Weather phenomena are seldom uniform even over short distances.

FAR § 91.155 allows helicopters to operate in uncontrolled airspace below 1,200 feet above ground level (AGL) with no specified visibility as long as clearance from clouds is maintained and the aircraft is flown at a speed that will allow the pilot to avoid obstacles. Many obstacles, however, are difficult to see at any speed even when there is no atmospheric restriction to visibility. It requires little deterioration of ceiling or visibility to create a dangerous environment while flying within several hundred feet of the ground.

Operating close to the ground, even helicopters with their superb maneuvering capabilities cannot always enable pilots to avoid obstacles such as wires or antennas. Abrupt maneuvers to avoid these and other obstacles in low weather conditions may prevent collision but may also place the helicopter in an unusual attitude. If the pilot subsequently encounters IMC, and it requires more than just a few seconds to regain visual meteorological conditions (VMC), spatial disorientation may cause the pilot to lose control of the aircraft and impact terrain or obstacles.

A National Transportation Safety Board (NTSB) report, *Commercial Emergency Medical Service Helicopter Operations*, noted:

> "Even if the pilot is instrument rated, current, and proficient in helicopters, success in coping with inadvertent instrument flight is not guaranteed. The FAA has reported that in tests with qualified instrument pilots, it took as long as 35 seconds for some of the pilots to establish full control of the aircraft by instruments after the loss of visual contact with the surface. These tests were conducted with fixed-wing aircraft, which are inherently more stable than helicopters."

Helicopter cruise speeds, the NTSB said, can also easily overrun the pilot's ability to see and avoid hazards or deteriorating weather.

> "The effect of speed on the ability of the pilot to recognize a hazard (such as a cloud bank) and to react can be significant. It takes a helicopter pilot an average of 5 seconds to recognize a hazard, to determine what corrective action is needed, and to respond. A helicopter traveling at 120 knots (138 mph) will cover 1,012 feet in these 5 seconds. If the pilot reverses course and starts a turn, the helicopter continues to move toward the hazard for a distance equal to the radius of the turn. In a 30° banked, coordinated turn at 120 knots, this is 2,208 feet. Therefore, a pilot flying at 120 knots who recognizes a hazard and initiates a course reversal will travel 3,220 feet before starting to move away from the hazard. It should also be recognized that a 30° banked turn in marginal visibility can induce spatial disorientation in pilots if they are relying on outside visual cues to control the aircraft."

Accident Prevention

What can be done to prevent accidents that occur when it becomes impractical or perhaps even impossible to continue flight under VFR? Normal precautions in preflight planning cannot eliminate the risk of weather encounters completely. Virtually every professional pilot will eventually find him- or herself in a situation in which weather threatens the safety of a flight.

The following recommendations will significantly reduce the risk of weather-related accidents for VFR flights: [Note that the parameters suggested in the following may be more restrictive than minimums or requirements established by the FAR but NOT less restrictive.—*Editor*]

- Each operator should have weather minimums for VFR operations that are sufficient to provide reasonable assurance that pilots will not inadvertently encounter unsafe low ceilings and visibilities while en route.
- Pilots should be provided with a company-approved procedure to guide them if they encounter an inadvertent IMC situation. This procedure should specify minimum safe altitudes for obstacle clearance, current instrument navigation charts, and ATC facilities that a pilot can contact for assistance.
- [Operators should] provide recurrent pilot instrument trainingμ even if normal flight operations include frequent IFR operations. Without practice, the skills and knowledge necessary to prepare a pilot for successfully handling adverse weather degrade over time. In addition, maintaining instrument proficiency is more complex than simply satisfying the FAA requirement for recency of instrument flight experience. Among other things, it includes studying regulations, the *Airman's Information Manual*, and flight or simulator training with a qualified instructor.

Conclusion

The NTSB safety report also concluded:

> "Spatial disorientation or vertigo can be so overpowering that even when pilots are aware that it is occurring and are trained to rely on instrumentation, they may have difficulty in controlling an aircraft. The importance of spatial disorientation cannot be overstated, [because] 90% of general aviation accidents involving disorientation as a cause or factor are fatal. Special training and proficiency maintenance are required to reduce the risks involved in flying in IMC."

A flight operation that emphasizes flight safety and provides thorough instrument recurrent training for its pilots [may] experience a reduced risk of accidents while maximizing the use of flying hours. ■

Mr. Bearden is a ground/simulator instructor at FlightSafety International's Fort Worth, TX facility. This article originally appeared in Helicopter Safety, *a publication of the Flight Safety Foundation (not affiliated with FlightSafety International), 2200 Wilson Boulevard, Suite 500, Arlington, VA 22201–3306; (703) 522–8300.*

Three Hundred Moving Parts

Continued from page 11

"Perpetual Pilot Motion Machine"

If you have ever taken a helicopter flight (and I suggest that you do), you will see that the pilot's hands are continuously occupied. The controls are in constant motion to maintain stability in the helicopter. For this reason, among others, the helicopter pilot must master some fine and sensitive control touches. The helicopter pilot must essentially become a highly skilled and competent flyer and, contrary to popular belief, be a safe, conservative aviator. You would too if you controlled "300 moving parts!" Unfortunately, because of the occasional sensation-seeking reporter and a very few irresponsible pilots, you may have the wrong idea of our abilities and intent.

Similarly the noise of helicopter flight all too often drowns the lifesaving, knowledge-gathering good helicopters do. Rather than being known as a converter of aviation fuel to noise, I would like to see the air ambulence flight or the mountain rescue flight or the essential supply flight or the news-gathering flight dominate our image.

So, yes, we do good work, and we are responsible, competent pilots flying safe, able, and reliable machines. I know you are, too.

Let's get together some time and talk. ■

Mr. Jaffe is the Chief Pilot for Boston Helicopter Company and an Accident Prevention Counsellor for the Bedford, MA FSDO. This article originally appeared in the Bedford FSDO's newsletter, FSDO 1 Communicator, *published by APPM John Hemmes.*

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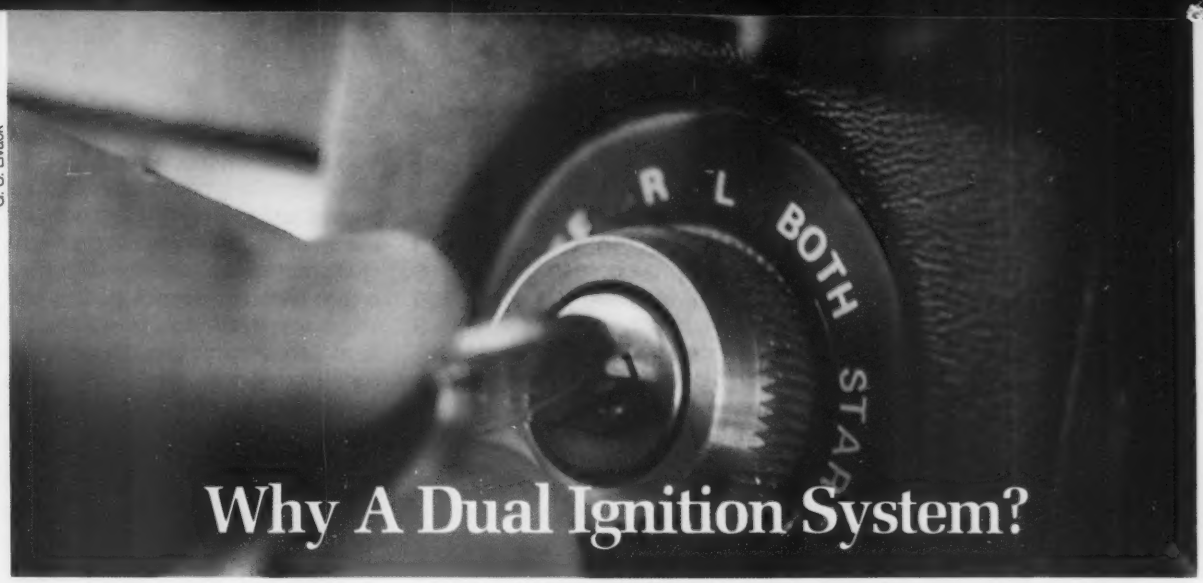


G. S. Livack

Why A Dual Ignition System?

by Henry Davison

Standard aircraft engines (Lycoming, Continental, etc.) have independent, dual ignition systems. However, false logic prevails when most general aviation pilots respond to the question, "Why dual ignition?" The usual answer is "For safety—in case one system fails, the other takes over." No doubt; however, safety covers a wide spectrum of definitions, but this logic is not the main reason for dual ignition. Normal engine operation requires that both ignition systems function properly and simultaneously. This is not to be construed as both mags firing at the same instant. Not so—on some engines the mags are timed two degrees apart as prescribed by the engine manufacturer. As this article progresses, we will see why a pilot should not elect to take off with one magneto inoperative or otherwise malfunctioning. Remember—it's a lot better when you are down here wishing you were up there than when you are up there wishing you were down here.

Theory of Operation

Once normal ignition occurs in a cylinder, the fuel/air mixture burns at a relatively slow rate, providing continued expansion of kinetic energy that pushes against the piston throughout its power stroke. Although less intensive, this same fuel/air mixture still continues to burn as it passes through the exhaust port on the return trip of the piston (exhaust stroke). At night a blue flame would be visible emitting from the exhaust stacks if the mufflers were omitted. The fuel/air mixture burns at a rate comparable to that of a gas stove.

The dual magnetos produce prolonged ignition for a period of time (measured in micro-seconds) that starts two flame fronts when the piston is well advanced of top-dead-center (TDC). More specifically, this ignition event occurs approximately 28 to 30 degrees before top-dead-center (BTDC) as it relates to crankshaft rotation. By the time the piston arrives at TDC, the expanding gas has reached maturity and is ready to do its thing. During the power stroke the piston actually accelerates from zero movement at TDC to its fastest movement at midpoint of travel, then decelerates back to zero at bottom-dead-center (BDC). This phenomenon is because of the rotating crankshaft throw position and the connecting rod reciprocating action. The fuel/air combustion process is very much in harmony with this piston movement, providing a graceful transition of power to the crankshaft.

If only one ignition system is operative and producing a single flame front, the combustion process is retarded. This retarded energy is just the opposite of what is required as the piston accelerates to its peak velocity at midpoint cylinder travel. Instead of the energy being depleted gradually during the second half of piston travel when decelerating, the delayed-burning gas is still prosperous. The piston then is unable to absorb the prolonged energy, and the suppressed burning gas results in higher combustion temperature, causing uncontrolled burning (detonation). This condition usually does not present a real problem during cruise flight at 75% or less power for a normally aspirated engine, provided the mixture has been leaned properly. On the other hand, the condition intensifies during takeoff and climb-out. With insufficient cooling at slower airspeeds, detonation could cause severe engine damage.

If one magneto is functioning normally, but the other abnormally, it is conceivable that the defective magneto could ignite the fuel/air mixture prematurely negating the good magneto. Consequently, an aggravated assault by detonation could be devastating to the engine. When severe detonation occurs, it usually burns a hole right through the piston adjacent to the cylinder wall. Then all of the crankcase oil makes a fast exodus through the breather tube. As Paul Harvey might say, "You can predict the rest of the story."

Spark Plugs

The spark plugs have the final say when converting magneto electro motive force (EMF) to ignition spark; therefore, the plugs should be at their

best behavior. A few factors to be cognizant of concerning spark plug integrity are as follows:

1. Spark plug/engine compatibility
2. Heat range of plug
3. Electrode gap setting
4. Condition of electrodes

Spark Plug/Engine Compatibility

Both spark plug and engine manufacturers working together determine the proper type plug suitable for each engine model. Extensive flight testing is conducted through a wide range of operating conditions and at different power settings. To eliminate any possibility of error in spark plug selection, both manufacturers provide spark plug data charts as a guide. It makes safety sense then to take full advantage of their combined expertise.

Heat Range (Hot and Cold Running Plugs)

For specific operating conditions, you may have the option of selecting a hot or cold running plug. The terms "hot" and "cold" refer to the plug's ability to transfer heat from the firing end to the engine cylinder head. A cold running plug transfers heat more readily; therefore, it is normally recommended for a relatively hot running engine. Conversely, a hot running plug transfers heat more slowly; therefore, it is recommended for a relatively cold running engine.

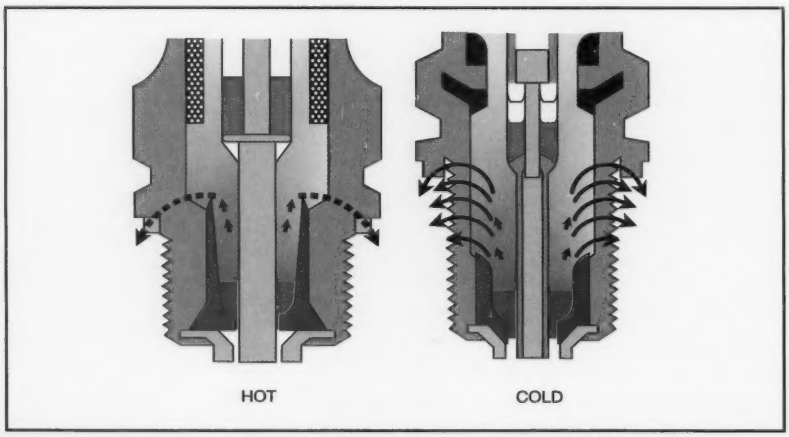
Operating temperature of the plug insulator core tip is one factor that governs the function of troublesome combustion deposits, namely carbon and lead. Plugs are susceptible to these deposits when the operating temperature of the insulator core tip is at or below 800 degrees F, but an increase of just 100 degrees F is sufficient to vaporize such deposits. By employing the proper heat range plug when applicable and by avoiding prolonged idle rpm on the ground and in the air, spark plug fouling should succumb.

Electrode Gap Setting

The size of the electrode gap has a definite effect on spark plug service life and on engine performance. An incorrect gap setting will not only cause misfiring during idle but will also misfire during cruise power when the mixture is leaned. This intermittent firing lowers the plug insulator tip temperature to such an extent that combustion deposits may not vaporize sufficiently to keep the plugs from fouling.

Condition of Electrodes

The spark plug center electrode tip should be flat with a relatively sharp edge instead of being rounded with an indefinite edge. The ground electrodes should be hefty instead of being eroded thin. On fragile ground electrodes, a correct gap setting cannot be maintained for long. Even though the plugs seemingly fire okay in this deteriorated condition, the spark burn time is shortened considerably, degrading engine performance and wasting fuel. When the electrodes are eroded as described, it is time to make a change. As the saying goes, "You can pay now, or you can pay later."



The length of the nose core is the principal factor in establishing the plug's heat range. "Hot" plugs have a long insulator nose that creates a long heat transfer path, whereas "cold" plugs have a relatively short insulator to provide a rapid transfer of heat to the cylinder head. (from the Airframe and Powerplant Handbook*)*

Magneto Periodic Inspections

When it comes to magneto periodic inspections in the way the factory recommends, false logic again intervenes: "If it ain't broke—don't fix it!" When performing 100-hour or annual inspections, maintenance personnel check the magneto timing to the engine and run the engines to determine satisfactory performance regarding power output, static idle rpm, magneto grounding check, and the rpm drop when checking the mags during the run-up. The magnetos are not usually removed and inspected unless a problem is evident. Consequently, magneto integrity and longevity are compromised.

Teledyne Continental Motors (TCM) recommend that its product lines of Bendix magnetos be disassembled and given a detailed inspection at 500-hour intervals. TCM's Service Bulletin No. 632, "Maintenance Intervals for all TCM and Bendix Aircraft Magnetos," issued in November 1989, further emphasizes several important inspection/overhaul intervals. In its manuals, Slick Magneto Division also recommends periodic inspections and overhaul maintenance. The maintenance schedules are varied according to the magneto model and serial number.

Since 1985, the National Transportation Safety Board (NTSB) has cited magnetos as a cause or factor in 92 accidents involving 22 fatalities and 21 serious injuries. A multitude of Service Difficulty Reports concerning magnetos have also been submitted to the FAA during this period. These reports include 130 instances of cracking, burning, arcing, leaking, or other deficiencies in certain magneto ignition coils.

I have experienced an engine failure on an aborted landing because of magneto problems. The aircraft had been purchased a couple of months earlier in northern New Mexico where sandstorms are prevalent. Both magnetos, when removed after the engine failure, were found to be infected with very fine, pulverized dust. The dust wore down the breaker point cam block to the extent that the maximum point opening was only .003 when it should have been approximately .016 to .018. In addition, the foreign dust had mixed with the carbon brush dust to form a carbon track around the distributor block. This could have resulted in a premature firing in a cylinder next in the firing order. This is because of the lower compression cylinder offers less electrical resistance at the spark plug.

The FAA believes that periodic inspections, overhaul, and replacement of critical components are important fundamental facets of magneto preventive maintenance. An examination of accident reports and Service Difficulty Reports make it clear that the current level of magneto inspection, maintenance, and service is much too infrequent.

There are unknown numbers of airplanes that have been stored or otherwise used infrequently and may not have accumulated sufficient total flight time to require that obsolete magneto ignition coils and/or rotating magnets be replaced with more reliable parts in accordance with AD 73–07–04 or other service information. Ignition coils are adversely affected by the environment over relatively long periods of time. They should be replaced and subsequently inspected at conservative intervals of calendar and flight time.

Such severe environmental operating conditions as engine overspeeds, sudden stoppage, immersion in water, and any other circumstances that require complete or partial engine overhaul before the regular overhaul time can and do adversely affect engine operation. The magnetos are an integral part of the engine and are subject to the same degenerating forces as the engine. In such circumstances the magnetos, regardless of in-service time, should be overhauled with particular attention focussed on all rotating parts, bearings, and electrical components. I have seen a magneto rotating magnet that was sheared in two by an engine backfire where the crankshaft reversed direction for several revolutions.

It must be remembered that any maintenance performed on magnetos must be done by a certificated powerplant mechanic or certificated repair station. Also, the periodic inspections and overhauls require special tools mentioned in the factory maintenance manuals. A seemingly insignificant task such as adjusting or changing the breaker points requires a special timing device to set up the magneto internal timing. The rotating magnet must be positioned precisely with respect to the field magnets for the maximum build-up of magnetic flux. This set-up is called "E gap." With E-gap established, the points are set to open at .0015 (based on standard atmosphere of 29.92" Hg) which collapses the magnetic field to initiate the ignition spark at the appropriate spark plug. There is quite a wide range of maximum point gaps allowed in most magnetos, but the important thing is when the points break (.0015) at E-gap, not the maximum opening gap, so long as it is within specified maximum/minimum settings stipulated by the manufacturer.

Conclusion

Here are a few final considerations about the care and feeding of the magnetos in your dual ignition system.

Magneto Bearing Lubrication

Who would ever think that the magneto bearings require a special lubricant that helps prevent flash-over? If regular bearing grease is used, flash-over could pit the bearing surfaces, shortening component service life.

Handling Magnetos

It is an awful temptation to spin over a freshly overhauled or new magneto while watching the spark jump across the high tension outlets to the housing ground. When you do this, you just voided the warranty, and most of all you may cause a coil breakdown at the most inopportune moment. The EMF energy buildup in the coil seeks an escape route wherever it may be at the point of least resistance. Eventually, the secondary winding insulation could break down rendering the coil inoperative or intermittent when heated up in service. Secondly, the magneto should be handled with care. A sudden jolt caused by hammering on its components or dropping it could degrade the magnetism in the field and/or rotor magnets affecting magneto performance.

Live Magnetos

A parked airplane without continuity between the mag switch and the magneto, regardless of whether the switch position is at OFF, has a hot (live) mag; therefore, every propeller coupled to an engine must be handled with as much respect as a loaded gun. The propeller does not have to be rotated very much to activate and discharge the magneto impulse coupling. This coupling mechanically retards the magneto-to-engine timing and spins the magneto's rotor over quickly to generate enough EMF to start the engine easily. Even if the mixture is in idle-cutoff, there could be enough fumes in the cylinder to give one more swift kick to an unfortunate and complacent individual.

Run-up/Mag Check

If the mags are accidentally turned off during the run-up mag check, the throttle should be returned to idle before the magneto switches are turned back on. [Consult your pilot operating handbook or flight manual for the manufacturer's recommended procedure.—*Editor*] This procedure negates the afterfiring event that is sure to follow otherwise. Afterfiring could be violent and result in damage to the exhaust system. ■

Mr. Davison is an A&P mechanic, a flight and ground instructor, and an Accident Prevention Counsellor for the FAA's Baltimore, MD Flight Standards District Office.

Dean Chamberlain

GPS, Looking Towards the Future

by Dean Chamberlain

The Aircraft Owners and Pilots Association (AOPA) recently conducted demonstrations of Differential GPS (DGPS) precision instrument approaches at its Frederick, MD headquarters. The media were invited to participate in approaches comparing both DGPS and ILS, flown in AOPA's A–36 Beech *Bonanza*. AOPA used the same *Bonanza* in the FAA/AOPA GPS non-precision approach test program earlier this year at the FAA Technical Center at the Atlantic City (NJ) International Airport.

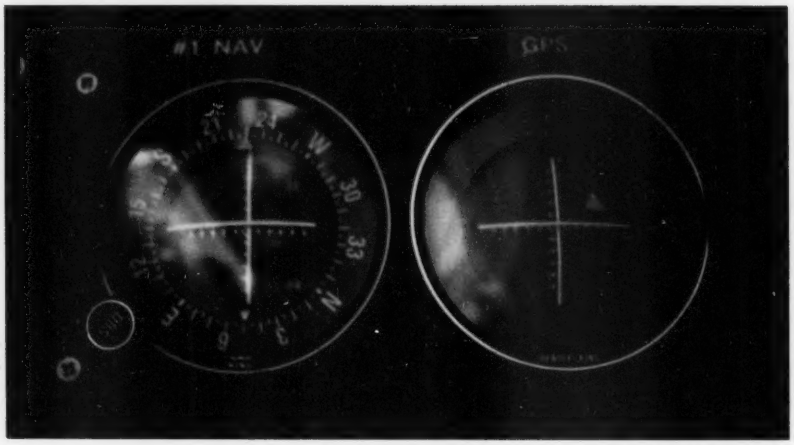
The briefing and flight demonstration by AOPA's Drew Steketee highlighted the ease with which pilots could be flying DGPS precision approaches, just as they will soon be flying GPS non-precision approaches regularly once GPS receivers meet the FAA's new Technical Standard Order (TSO) C–129 for IFR certification.

As reported in the September issue of *FAA Aviation News*, the FAA approved the supplemental use of GPS in June. Initially, GPS may be used to fly current non-precision approaches pending development of GPS specific approaches. Research is ongoing regarding the future use of GPS for precision approaches, which provide descent guidance as well as navigation to the runway.

During its ongoing test program, AOPA will use two means to provide Differential GPS information to the A–36. During the recent demonstration flight, AOPA used an FAA-provided differential ground station that uses a one-way VHF radio frequency data link to transmit information to the aircraft. Later, AOPA will lease the sub carrier on a local commercial FM radio station to transmit differential corrections to the aircraft.

For those not familiar with Differential GPS, it uses a ground-based, survey-quality GPS receiver and associated communications equipment to transmit differential information to GPS-equipped aircraft in the transmitter's local area. The airborne receiver then uses the information to make precise corrections to satellite navigation data. As a result, differential GPS can increase the accuracy of commercial GPS receivers from their normal horizontal positional accuracy of about 100 meters to within a few meters. The vertical positional accuracy is also improved dramatically

AOPA President Phil Boyer emphasized AOPA's long-term endorsement of GPS and its advantages for general aviation in particular and aviation in general. Key points included the potential of a single GPS receiver being able to replace many different navigation boxes in a cockpit while providing more information to the pilots; the potential ability for the FAA to design GPS approaches for every airport; and the potential monetary savings governments may realize from having a space-based navigation system that does not require some type of transmitter to be purchased, installed,



and maintained at each approach site as the current ground-based system does.

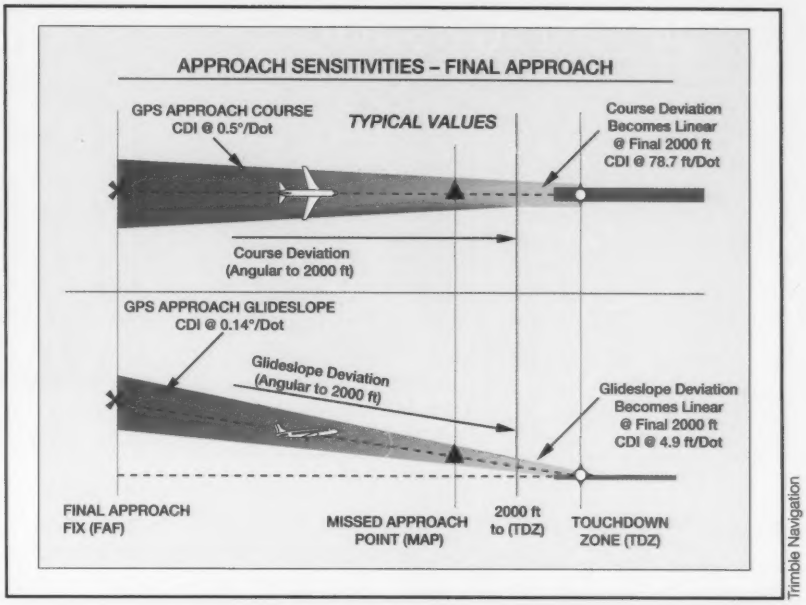
During the demonstration flight, two instrument approaches were flown. One approach, emulating the published Frederick ILS 23 approach, was flown to show a comparison between the ILS guidance and those of a GPS-derived guidance. The other approach demonstrating the versatility of GPS was established on Frederick's runway 12 where nearby mountain ranges would make ILS impossible. The GPS approach featured a customized four degree "glide path" designed to overfly nearby mountains and noise sensitive neighborhoods.

In both approach demonstrations, the *Bonanza* with ILS and GPS displays for both the pilot and copilot showed little variation between its ILS and GPS indicators as the aircraft flew the two approaches. The major differences between the two displays were in the display needles' sensitivities and projected touchdown points on the approach. An ILS indicator displays angular course guidance to touchdown; ILS course sensitivity increases as the aircraft gets closer to the ILS transmitters.

The GPS display starts out angular, but it switches to a linear sensitivity mode within 2,000 feet of the runway. Linear course guidance keeps the GPS needles' sensitivity constant to touchdown. Course guidance is not overly sensitive or erratic as the aircraft gets closer to the runway, making for easier and smoother approaches.

In comparing GPS to ILS/VOR, some of the benefits that production FAA-approved GPS approach receivers should provide pilots may be the ease and reduced workload needed to fly an approach. Approved IFR GPS receivers will be programmed to provide sequential navigation steering information automatically from the initial approach fix through the missed approach point and on to the missed approach holding fix. The potential for a pilot's being able to fly a complete published approach without having to tune, adjust, or set in any other navigation information may be the greatest benefit of GPS, especially for single pilot IFR. Another important benefit may be the constant position and other flight and airspace information available to a pilot throughout the approach. Why, we may reach the point where it might become impossible for a pilot to get lost in flight.

No, on second thought, some pilots will probably forget to turn their GPS receivers on. As history has proven, there will always be room in a cockpit for Murphy and his laws.



Trimble Navigation

AOPA

A pie-shaped GPS receiver antenna and mast-mounted DGPS transmitter antenna were installed on the roof of AOPA's headquarters at Frederick Municipal Airport MD.

But all joking aside, GPS has the potential of being the greatest thing to happen to aviation since the Wright Brothers first flew. Time and GPS operating experience will tell how great.

The work of AOPA and others within the industry with the FAA in developing the DOD-funded and operated GPS for civil aviation use is an example of how the aviation industry and the FAA are working together for the benefit of all. ■

FAMOUS**FLIGHTS**

The First Non-stop Transcontinental Flight in the U.S.

Macready Foundation/Sally M. Wallace

by Sally Macready Wallace

Part 2

In the years following World War I, the fledgling U.S. Army Air Service was fighting for its very existence. In an effort to prove the worth of aviation, a non-stop transcontinental flight was proposed. ***—Editor***

On November 5, 1922 Lieutenants John Macready and Oakley Kelly jumped out of the engine-damaged Fokker T–2. They were *through*—no more talking of transcontinental flights after this second failed attempt. They left Indianapolis and returned to Dayton for a few days rest. However, it was not long before the U.S. map was once again up on the wall in the pilot's lounge and before they knew it, they were planning a third attempt.

While waiting for favorable weather, Macready and Kelly attempted another endurance record to test the engine and plane, but even these flights were beset with frustrations. On the first try, the mayor and influential citizens of Dayton, were out en masse to bid them "Godspeed." The movie cameras were rolling, they were slapped on the back and wished good luck as they climbed in the plane for the two day flight. Macready said later; "We waved to the multitude, 'gave 'er the gun' and rolled down the runway. . . only to get stuck in the mud up to the hubs 50 feet down the runway."

The second try was not a whole lot better. They got off the ground with an experimental high compression engine and remained in the air for approximately eight hours, at which point the engine quit. It was pitch black with temperatures of eight degrees above zero in very bad weather. They were not sure of their exact position in relation to the field; there were no lights and they were losing altitude fast. Luck was with them. Macready spotted a light on top of a building and headed for it, landing with a thud. The only damage, other than to their egos, was a bent spreader between the landing gear.

Finally the weather reports looked favorable. By this time they had made a drastic change in their route, reversing the direction of flight and flying from east to west to take advantage of the Hudson Bay High during which the prevailing winds blow east to west. Flying the T–2 to Washington, DC, the two pilots put in their weather order. Without a good tailwind, the success of the flight was questionable as fuel exhaustion would occur before they reached their destination.

At 10:00 a.m. May 1, 1923, they received this weather report:

New York to Dayton, Ohio, northeast and east winds, clear sky; Dayton, Ohio to Kansas-Missouri line, low clouds and rain, east winds; Kansas-Missouri line to San Diego, clear sky, variable winds.

They hesitated. The idea of low clouds and rain at night over the Ozark Mountains was not an appealing one. These were conditions to avoid, but the rest of the weather looked good and they decided to go for it. Here again, the first roll-out down the runway, with a crowd of well-wishers waving them off, ended in ignominious defeat. After rolling at top speed for almost a mile over the ground, the huge, heavily laden transport displayed no sign of rising into the air and trees and wires lay directly ahead.

They aborted takeoff and the T–2 taxied back to another position. Roosevelt Field, Long Island (now a racetrack) was a plateau about one mile square. Hazelhurst Field was about the same size and adjacent, but 20 feet below. They pointed the nose of the airplane toward the aerial mail hangars on the far side of Hazelhurst Field, some two miles distance, and again waving goodby to the group of now-anxious spectators, pushed the throttle forward and the plane lumbered heavily over the ground. "It bounced and bounced down the runway but did not rise," Macready wrote later in the *National Geographic Magazine*. It was still on the ground when they came to the 20 foot dropoff between Roosevelt and Hazelhurst Fields. Over they went, and the plane settled back toward the ground, but not quite to earth. The T-2 was flying, but without any apparent climb, and the big hangars were still

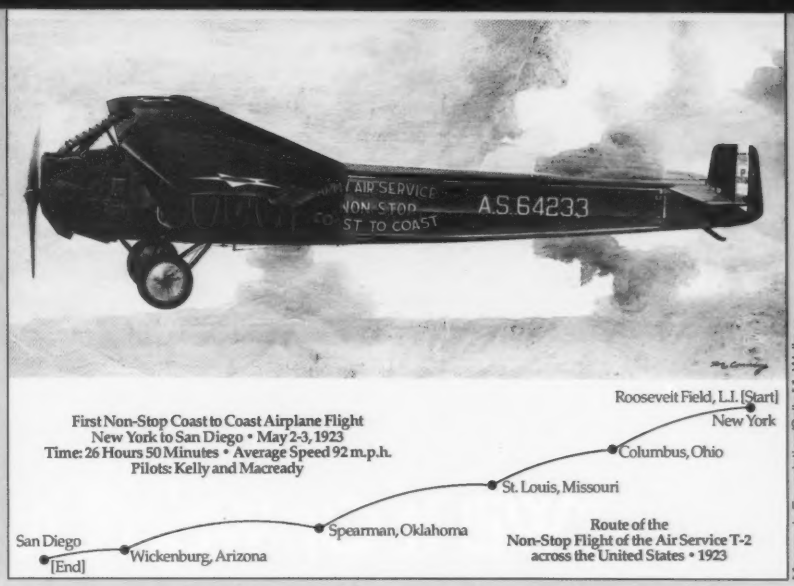
directly ahead. When they got to the hangars the plane "just sort of flopped over them."

The heavily loaded plane only just maintained level flight. For 20 minutes over Long Island their climb was hardly appreciable. In fact, for the first few miles they barely cleared the poles and wires. They were over Pennsylvania before they could climb above 400 feet. During the daylight hours they navigated by the compass, section lines, and railroad tracks and checked the wind direction by bonfires or chimney smoke. At night it was a different story. Navigation was solely by compass and the occasional flicker of automobile lights on national highways. Lights from cities helped to orient the flyers.

Over Terra Haute they were only 800 feet above the ground. It was nighttime but they could distinguish the river going through the center of the city. They were flying in a light mist under heavy cloud cover as they pressed on toward St. Louis, MO. Macready up front noticed a faint flicker on the propeller that seemed to come regularly and grew stronger as they flew on through what was now a full fledged storm with rain, thunder, and lightning.

A few months before the flight, the new Sperry high intensity aviation beacon had been developed and was being tested on this flight. The Sperry Beacon proved to be a real aid to air navigation and helped make aviation history on this flight as Macready's own words attest: "Approximately 50 miles from Belleville, IL, in total darkness at 2,000 feet altitude, we were thrilled by the sight of a huge beam of light projecting up through the clouds. It was a veritable beacon along a rocky and dangerous shore to us, for otherwise we were trusting solely to the compass to keep on a straight course. Aided by this beam of light, which we knew came from Belleville, we continued straight as an arrow for the Missouri River."

A little after midnight the plane suddenly came out from under the dark, dismal clouds into bright moonlight, a very welcome sight. Kelly now took the controls and flew during the night to



Macready Foundation/Sally M. Wallace

Santa Rosa, NM. Their first positive navigation point after the long night flight was Tucumcari. NM. They reached it at daybreak and recognized terrain they had flown over on a previous flight. They were right on course! It looked as if they were really going to accomplish their goal at last.

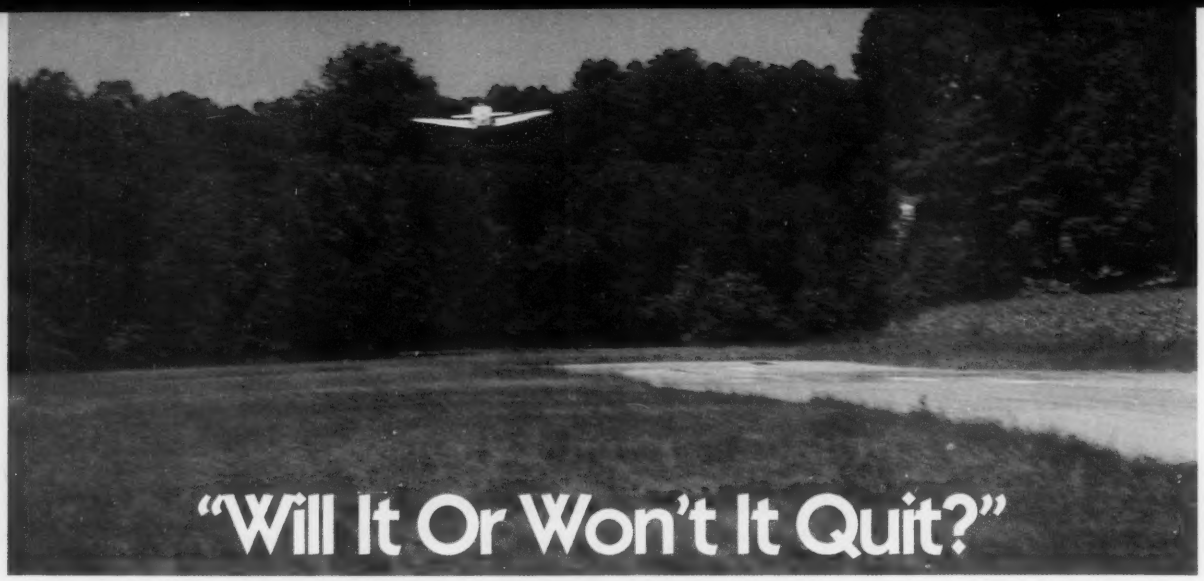
Macready took over at Santa Rosa, NM. Being a San Diego boy, he would fly the final leg and land at San Diego to give the hometown folks a treat. Once he reached the Rio Grande he knew he was seven hours from touchdown. There was nine hours of fuel left. If he could just get over the upcoming mountains, success was assured.

The T–2 was struggling for altitude as each gallon of gas burned off. Once more they were confronted with the Continental Divide and once more they were unable to push the Fokker high enough to clear the mountains. As before, they had to look for a new route, a gap in the divide. Flying south, Macready found the opening he needed and with 100 feet to spare, cleared the highest point of the flight.

As they approached San Diego there was a feeling of elation in the cockpit, but they were eager to land and planned no flourishes over the city. According to Macready's note: "Diving down from 8,000 feet with power on, we reached San Diego, cocked the T–2 up on one wing to swing down the main street and passed about 100 feet above the tops of the buildings. I noticed something black on top of those buildings and was greatly surprised to observe that it was people. People waving sheets, coats, hats, anything they could get their hands on." Sirens were blaring from fire engines, ships in the harbor tooted their horns, as did automobiles on the streets, and there was a general din below of which the pilots were unaware. They wasted no time. The Army Air Service Fokker T–2 made one turn of North Island to head into the wind and landed exactly 26 hours 50 minutes after taking off from Long Island, NY, thus accomplishing their goal of the first non-stop transcontinental flight.

After three attempts, two crack military pilots had achieved the impossible with the help of elaborate preparations (including a specially equipped airplane) and shear determination. Of course the Air Service chose to forget these facts when they extolled the virtues of aviation and how both the military and businessmen could travel faster and further by air. According to the Air Service this flight proved that commercial aviation was "born" and off and running! ■

Sally Macready Wallace is the daughter of John A. Macready. She is the President of the Macready Foundation and is currently serving on the Board of Directors of Castle Air Museum of Merced, CA.



"Will It Or Won't It Quit?"

by Robert J. Hawkins, *CFII*

Student pilots spend endless hours practicing emergencies, but it doesn't end there. Instructors chop the power and say "Surprise!" to licensed pilots during their biennial flight reviews, pilots working on their commercial or ATP rating, or just pilots who want to brush up on their procedures. And those instrument students—much of what they do is "what do you do if. . . ."

Collectively we spend countless hours thinking and worrying about emergencies. Many of us fly for years or our whole careers without ever having a real emergency.

Over the last 30 years of flying I have encountered my share of vacuum pump failures, electrical system failures, ice—both on the wings and in the carburetor, "bad gas," plugs that just don't run smoothly, and a myriad of other problems. Some situations are memorable, and most have been forgotten, but I think I have learned a little something from each one.

In every case, I believe, I took the time to calmly look, evaluate, and determine the course of action to be taken. None of the situations were a true "emergency." That is, until last night.

A Real Emergency

My student and I were in an airplane and we were shooting a practice ILS at Frederick (FDK) Airport (Maryland). However, it could have been anywhere, since this approach is a typical ILS. The approach itself went well, but during the initial climb-out portion of the missed approach the engine started running roughly, *very* roughly.

This time there was no calm analysis of the situation. Somehow I knew we didn't have a lot of time. Immediately I switched fuel tanks, just in case the problem was contaminated fuel, and told the student to turn on the fuel pump and to declare an emergency on the CTAF. Then I made sure the mixture, throttle, and prop were forward; took the controls; and turned toward the airport. In my mind the engine was sounding worse with each second, but it continued to run through the landing and we were able to taxi to the ramp, shut down, get out, and sit down to consider our good luck.

I found out the next day that the rocker arm assembly on the number 1 cylinder had failed and taken the push rod and valve with it. The mechanic told me that when he removed the rocker arm cover parts came spilling out. The entire rocker arm assembly had been destroyed.

The first major decision was to fly the airplane in the first place.

A Postmortem

In reviewing this situation I saw that there were many questions calling for decisions. The first was: Would the plane make it back to our home base some 17 miles away? I didn't want to try and find out, even though the mechanic said it would probably have run for at least another 10 or 15 minutes! More importantly, we were within two miles of a 5,000–foot runway. What would you do?

Now let's look at what we did. A review of the events brings to light the decision points that occurred. At the time I was not particularly conscious of having made them; they were almost instinctive. In reality, however, they were the result of training and discipline taught me by my instructors and my students and reviewed frequently by my peers.

The Decision Process

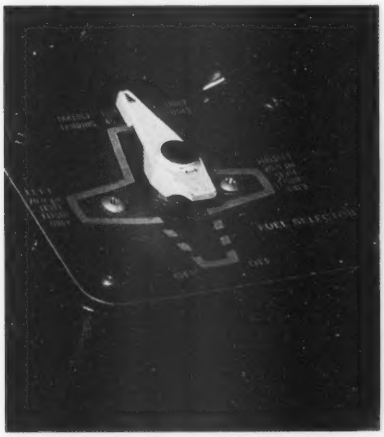
The first major decision was to fly the airplane in the first place.

Next, could we have found this mechanical problem during the preflight? No. The reality for all of us is that in some situations we just don't know something will happen until it happens. Should we forego the pre-

flight just because we wouldn't find this type of problem? Again, no.

Let's move ahead to the actual start of the failure, or rather just before it. Most instructors and pilots who take flying seriously are subconsciously aware of the possibility of engine failure, and we tend to evaluate the situation constantly. This, by the way, may be what makes many CFI's a pain in the behind when it comes to following checklists and procedures in general. In this case, while the student was flying the missed approach, I was doing several things: looking for traffic both conflicting and in relationship to our position, listening to and watching the student, and making a mental note of where we were in relationship to the airport in general. These points, and I am sure many others, are the result of many hours of being drilled by instructors in "position awareness"—know where you are and what's around you.

When the engine started to run roughly, we had to decide what to do or whether to do anything at all. Many times I have encountered carburetor ice, bad gas, or fouled plugs, and each of these occurrences has a distinctive and subtly different sound and feeling and requires a different solution from the pilot. When I saw the RPM's drop and felt the whole plane vibrate, I didn't care what the problem was.



"Immediately I switched fuel tanks, just in case the problem was contaminated fuel, and told the student to turn on the fuel pump and to declare an emergency on the CTAF."

Don't upset your passengers, don't create panic, be decisive and definitive, and give clear and concise instructions.

Such sensations are the basis for the decision to *get it on the ground NOW.*

Fly the Airplane

How can you teach these concepts? You can't. My student and I now know what an eminent engine failure sounds and feels like. I am not sure I can pass that sense and feeling on to my other students. What I can try to teach them is that when the moment comes to decide, make the most conservative decision possible and make it fast. If you have to think about it, it may be too late. In an instant I decided to return to the airport and land—no quibbling, no thinking, just reaction based on "pilot instinct."

Yet, at this point several things were also happening. There were other aircraft in the pattern, and we needed to notify them that we thought we had a problem. Declare the emergency! Other pilots would collectively prefer to get out of your way when you are experiencing an emergency, but they are not mind readers and you need to tell them what is going on. This is not a time to be shy or macho. Your ego, possible sense of embarrassment, or even the thought of "crying wolf" have no place in a shaky, noisy, possibly broken airplane.

Next was the decision to maintain altitude, establish the best attitude with the remaining power for as long as it lasts, and prepare to pitch for best glide when the powerplant fails. Textbook, all the way, but the feeling was nothing like the descriptions in the books or those easy-going simulated engine-outs I've practiced so often.

Getting It on the Ground

Making an inside entry to the downwind leg of the traffic pattern is not one of my favorite maneuvers. Although it is not actually illegal, I don't think this type of entry is good operating practice. However, in this case we had an emergency, and the decision to make that entry was part of the overall decision to get on the ground. This was not the time to go out and make the standard 45–degree outside entry to the downwind. The key factors here were to be careful and not waste position, airspeed, or altitude.

As we were turning from a short downwind to final I was thinking about how putting the gear down early could create a lot of drag and could keep us from a successful landing, especially if the engine quit. So we held off on the gear until we were on final and were confident we could make the runway as a glider. Meanwhile, we maintained our altitude and made shallow banked turns toward the end of the runway, lining up for final approach.

Within a few seconds the runway was under our nose, and we had gear down and full flaps. It is surprising how quickly a manually-activated gear comes down when you are under stress. The next issue was whether to

"When I saw the RPM's drop and felt the whole plane vibrate, I didn't care what the problem was. Such sensations are the basis for the decision to get it on the ground now."

"Meanwhile, we maintained our altitude and made shallow banked turns toward the end of the runway, lining up for final approach."

reduce power. With a sick engine, this can be a critical point. It's highly probable that when you change the power setting on an ailing engine, it is going to quit. When you pull that throttle back, you need to be prepared for an engine failure! I clenched my teeth and eased the powerback. My sweaty hand was so wet it almost slipped off the throttle, but to my relief that prop kept turning.

We were properly positioned and had the runway made, but, believe it or not, there were still more decisions to be made. Go back in your mind to all your training. What else is there to be done? Well, for one, unlatch the door and make sure your seat belt and shoulder harness are secure. For another, be prepared to get out of that plane ASAP! We could have had an engine fire and not known it. I don't even remember unlatching the door, but when we touched down I was not surprised when the door popped open.

Taxiing to the ramp was uneventful. I turned off all the electronics except for one radio and the intercom. When we shut the engine down, smoke billowed out of the engine from oil on the exhaust stack. I got out of the plane quickly and encouraged the others to do the same. There was no panic, just common sense with a bit of urgency. The others followed quickly and calmly, although in my mind there was still the potential for danger. I remembered the drill: Don't upset your passengers, don't create panic, be decisive and definitive, and give clear and concise instructions.

All these rules apply to decisions which must be made by the private pilot as well as the grizzled old ATP. They are all the result of training, repetition, and acquired habits. So the next time your friendly CFI simulates some emergency, remember that it is part of the overall learning process and is designed to develop in you the reaction process that is so vital to safe aviation. These are the circumstances where actions should occur without much thought.

Conclusion

A retrospective look at what happened vividly points out the need to practice procedures. I currently have about 50 hours in Mooneys and probably 500 in similar high performance retractables, but in the last 30 years of flying I've only got two to three minutes of eminent engine failure time, all in the last 24 hours. And during those two or three minutes, I was convinced that the engine was going to quit any second, and the decisions I made were based on that gut feeling.

In discussing this situation with some of my peers there was the observation that it might have been better to have let the student/owner land the plane so he could get the experience. This was a good point, but not one which I considered at the time. An emergency in progress is not necessarily the place to start your training. My wife said that she would be glad to speak with anyone who disagrees with this decision. She also said, "I know you. I don't know this other guy. I'd rather have you at the controls." (I pay her to say things like this.)

I hope I'll go more than another 30 years without another failure. Maybe I will, but the issue is that some of us will have these failures and, unfortunately, some of us will not handle the situation effectively. Each of us has to know our airplane and practice the procedures so that when something goes wrong we can make a decision and take the action we have been trained for. ■

Mr. Hawkins is a CFI and Accident Prevention Counsellor for the Baltimore, MD FSDO. This article originally appeared in the December 1992 issue of IFR Refresher *and is reproduced with permission,* © IFR Refresher.

"When you pull that throttle back, you need to be prepared for an engine failure!"

Question: *Does the 250 knots (288 mph) speed restriction apply throughout Class B airspace?*

Answer: No, only that portion below 10,000 feet MSL. Unless otherwise restricted by ATC, on departure you can automatically accelerate when passing 10,000 feet at those airports (Atlanta, Denver, Los Angeles, and San Diego) with Class B airspace above 10,000 feet. Likewise, you can hold your airspeed until descending through 10,000 feet.

Question: *Does the 200 knots (230 mph) rule under the Miami Class B shelves apply outside of 12NM?*

Answer: Yes. FAR § 91.703, Operations of civil aircraft of U.S. registry outside the United States, specifically states that FAR § 91.117c is applicable.

Question: *I'm still a little confused about Class E airspace, can you clarify it?*

Answer: One way to think of Class E, the general class, is by a default process. If it (the airspace) isn't Class A, Class B, Class C, or Class D, and it is controlled airspace, it is Class E. The variable with Class E is where does it start. Class E may begin at the surface (nontowered control zone), 700 and 1,200 feet (transition areas), Federal airways (VOR, colored, and Hawaiian), enroute domestic control areas, offshore control areas (low), and the former Continental Control Area, which has been redefined as Class E airspace extending upward from 14,500 feet MSL. By the way, in the western states, the Class E airspace beginning at 14,500 feet can be the floor of controlled airspace.

• ?°F =?°C

In the September/October 1992 issue of your magazine was an article written by TSgt. Rand M. Sanders about carburetor icing. First of all let me compliment the author as this subject is not always clearly understood by quite a few airmen. Under the heading "What causes carburetor ice?" it is mentioned that the temperature drop in the carburetor can be as much as 40° but is usually 20° or less. That is correct. Between brackets is mentioned the equivalent in degrees Fahrenheit and here a mistake occurs. When we just compare Celsius with Fahrenheit then—only then!—1°C is equivalent to 1.8°F. To add the usual 32 degrees is only done when we compare a temperature, but not when we compare just the value of the two degrees to each other as is done in this article. A drop from 40° to 20° Celsius is a drop from 72° to 36° Fahrenheit as the outside temperature is not important and irrelevant.

Rt. Hon. Capt. A.J.H. Cornelis BSc
Nonthaburi Province
Suanyai, Thailand

Thank you for pointing out an important fact about the two temperature scales. In reviewing your letter we found an interesting point in Webster's Ninth New Collegiate Dictionary regarding thermometric scales for our budding scientific buffs. There is a subtle difference between the Celsius and Centigrade thermometric scales although most Americans use the terms interchangeably. Celsius' interval between the triple point of water (the point where a substance exists as a gas, solid, or liquid) and boiling is divided into 99.99° with the triple point being .01° and the boiling point being 100°. The Centigrade scale has an interval scale of 100° with 0° as the freezing point and 100° as the boiling point. Either way one looks at it, .01° Celsius or 0° Centigrade, cold is cold.

• Did You Know

A friend gave me a copy of the July/August 1992 issue containing your story on the early days of crop dusting. I enjoyed the article and am happy to see that John A. Macready is getting credit for his fine contributions to early aviation. I would like to offer a few corrections and additions:

1. *Mr. Neillie was head of the Cleveland Ohio Parks Service and contacted Entomologist J.S. Houser of the Ohio Agricultural Experiment Station in Wooster with the idea of dropping insecticide on the tall trees of the Cleveland Parks.*
2. *Director Charles Thorne of the Experiment Station arranged the original contract with the Army Air Corps at McCook Field in Dayton.*
3. *The Catalpa grove was owned by Mr. H.B. Carver of Troy, OH, who approached Macready and Houser on his own asking them to try out this idea on his trees.*
4. *Army report records state the hopper contained 135 lbs. of lead arsenate and the total dusting time for the six acre plot was 54 seconds.*
5. *The entire test was photographed from the air by Lt. Kelly and Capt. A.W. Stevens using a DeHavilland airplane.*
6. *J.S. Houser noted in his report that Macready made a walking inspection of the entire woodlot prior to taking the plane up.*

It's always interesting how different memories remain of the same event... makes our jobs more interesting, I guess.

E. E. Whitmoyer
Historical Records Officer
Ohio Agricultural Research and Development Center
The Ohio State University
Wooster, OH

Thanks for sharing your information. Digging up historical facts is a lot like solving a mystery. You have to weigh the information you find and come up with your own conclusion.

As Macready is featured in this issue's "Famous Flights," it seemed appropriate to addendum one of his other aviation accomplishments.

• Straight-in Approach

What constitutes a straight-in approach at an uncontrolled airport? In other words, how far out from the airport do you have to be lined up with the runway to be considered straight-in? Advisory Circular (AC) 90–66, page 2, paragraph (d), states that pilots should be particularly alert for air carrier operations as they may execute a straight-in approach.

Gary S. McBride
Fayetteville, GA

The *Airman's Information Manual* (AIM) defines a straight-in VFR approach as "Entry into the traffic pattern by interception of the extended runway centerline (final approach course) without executing any other portion of the traffic pattern." Because each airport is different, there is no definition for how far out you have to be to be on a straight-in approach. For your

FAA AVIATION NEWS welcomes comments from its readers. We may edit letters for style and/or length. We will select one representative letter from those on the same topic for publications, and because of our bimonthly publishing schedule, responses may not appear for several issues. We will not print anonymous letters, but we will withhold names or send personal replies upon request. Address: Editor, FAA AVIATION NEWS, AFS–810, Washington, DC 20591.

• Safely Departed

Four of us have a question that we cannot agree upon. The question is about published IFR departure procedures for select airports. First of all why are they there? Then when do I have to follow them and under what conditions?

Gary S. McBride
Fayetteville, GA

The published IFR take-off minimums and departure procedures exist for those airports where the standard IFR minimums in FAR Part 91 do not provide the required level of safety. You are expected to follow the procedures when operating IFR. Conditions where the procedure is not required are published for specific airports and runways.

• Safety Pilot Update

I am enclosing a page from your old FAA General Aviation News dated May/June 1985. The article is about when a safety pilot needs a medical. I would like an update on your agreement that the safety pilot does not need a current medical certificate. In 1992 I was informed by someone from the FAA that I could not ride as safety pilot with an already instrument rated pilot current and qualified for the airplane and conditions of flight.

James A. Whitley, CFII
Shreveport, LA

The answer in the old issue is correct. A safety pilot who does not act as a required crewmember, as in the original question, does not need a current medical certificate. But if a safety pilot is a required crewmember, as in the case of being the safety pilot on a simulated IFR flight when the pilot flying is wearing a view restricting device, the safety pilot must possess at least category and class rating for the aircraft being flown and have a current medical certificate in case the safety pilot must assume control of the aircraft and act as PIC.

• Logging of Instrument Time

FAA Aviation News has received four letters asking about how to log instrument training in a ground training device. Rather than print the individual letters from Nolan G. Beck, Mark K. Walter, Howard G. Soloff, and Lloyd J. Probst, we will summarize their questions and answer them.

Each asked about logging time in a ground training device or simulator and if that time had to be signed off by an appropriately rated instructor. Several questions dealt with the question of maintaining instrument currency in a training device or simulator and if that time had to be signed off by an appropriately rated instructor.

Dean Chamberlain
Associate Editor

Since one writer also said we do not always answer the question asked, we will do our best to be direct. All instrument training and instrument currency training conducted in FAA approved simulators, airplane flight training devices, and ground training devices must be signed off by an appropriated rated instructor and logged as received in the specific device used for that training to count towards meeting any FAA requirement. FAR § 61.51(b)2,v, Pilot ground trainer instruction, describes this type of pilot experience or training received, and FAR § 61.51(c)5, Instruction time, states in part that pilot ground trainer instruction must be certified by an appropriately rated instructor. Pilots may not log ground training instruction time as either PIC or solo time. No one can solo either a simulator or training device. Nor can instrument instructors sign themselves off. Everyone can play to their heart's content, but for the time to be credited toward meeting any FAA requirement, the training device or simulator used must be FAA approved and the time signed off by an appropriately rated instructor

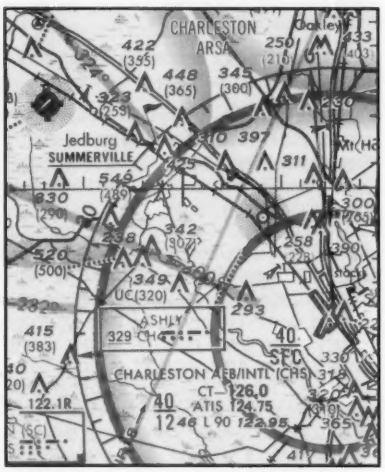
Finally, a significant point must be cleared up regarding ground instrument training. It appears that many pilots (and occasionally this magazine) have used the term FAA-approved simulator, airplane flight training device, and ground training device to mean the same thing. The terms are not interchangeable. Advisory Circulars (AC) 120–40, Aircraft Flight Simulator Qualification, and 120–45A, Airplane Flight Training Devices Qualifications dated February 5, 1992, describe the various types of such devices, the qualification requirements for each, and how each can be used in pilot training. AC 120–45A paragraph 14, also outlines the five year moratorium on the generic training devices described in the AC that have not been determined to meet the "level" standards listed in AC 120–45A.

information, AC 90–66, "Recommended Standard Traffic Patterns for Airplane Operations at Uncontrolled Airports," is being rewritten and straight-in approaches will be addressed in the proposed AC.

The FAA/industry Aviation Rulemaking Advisory Committee was actively involved in the rewrite, and the committee considered many industry ideas on straight-in approaches. Although the new AC will recognize straight-in approaches, the FAA recommends the standard left-hand traffic pattern as defined in the FAR and AIM. Because pilots may use different procedures, either intentionally or by error, all pilots must be alert for traffic conflicts near any airport.

• Veiled Comments

Recently a speaker at an EAA chapter meeting claimed that everything within the 30NM "transponder veil" of a TCA was "controlled airspace." I argued that the limits of controlled airspace were defined by the blue and magenta shaded areas on a



sectional chart and by the dashed boundaries of airport areas. I felt that the 30NM circle defined an equipment requirement and not controlled airspace.

Which one of us knows what we are talking about?

Jack Bennett
DeKalb, IL

You are correct. The 30NM TCA (now Class B airspace) veil is only a transponder requirement. FAR § 91.215 applies. By the way, the blue shading is no longer used with the magenta to indicate controlled airspace *(now Class E)* and solid magenta is used for ARSA's *(now Class C)* on sectional charts. An insert explaining the new symbology is included with each sectional.

Aerobatic Champion Donates Aircraft to the National Air and Space Museum

During ceremonies at Andrews Air Force Base on June 1, 1993, National Aerobatic Champion Patty Wagstaff and her husband Robert donated her *EXTRA 260* to the Smithsonian Institution in memory of the late Robert W. Wagstaff of Kansas City. Following a brief Aerobatic demonstration by Patty in the *EXTRA 260,* she presented the aircraft to Dr. Martin Harwit, Director of the National Air and Space Museum.

The *EXTRA 260* in which she won the overall 1991 and 1992 National Aerobatic Championships will be displayed in the Pioneers of Flight Galley next year.

Open Doors

Recently the Transportation Safety Board of Canada issued a safety recommendation that applies to pilots on both sides of the border. The Board is concerned about the number of Canadian accidents resulting from in-flight openings of doors on small aircraft. In its statement the Board said it reviewed accident data from 1977 to the present in the hope of identifying why pilots were having accidents when a passenger or baggage door opened on takeoff or in flight.

In its report, the Board reviewed 33 accidents in which a door opened either on takeoff or in flight. Ten people were killed in the accidents. Several interesting points were discovered during the Board's review. One was that the pilot experience level was generally high. Another was in 30 of the accidents the door was either not properly secured or was left open during preflight. The Board noted that most small aircraft do not have a conspicuous visual indication that a door is not secured nor are such aircraft equipped with a "door-open" warning device in the cockpit. *The most important fact the Board noted in its investigation was that in all 33 accidents the aircraft should have been capable of controlled flight with the door open.*

Part of the Board's recommendations concerned hardware recommendations. One recommendation is to encourage manufacturers to add secondary door latches and to design better visual indicators of unlatched doors. The Board noted some manufacturers and after-market manufacturers sell kits to modify doors for more security.

Most of the Board's comments concerned pilots and their training. The Board recommended to Canada's Department of Transport that because of the inadequate pilot response to a door opening on takeoff or in flight that all pilots receive training on how to handle such a problem either as part of their student training or as part of their refresher training.

A door ajar on the ground is easier to close than one in flight so be sure all doors are securely shut before you leave the ground.

The Board said in part, "An open door in flight can generate extensive noise, airframe buffeting, loss of lift, increased drag, and adverse aircraft stability. In the data sample, all 33 aircraft should have been capable of controlled flight with the door open. However, the distraction, pre-occupation, channelized attention, panic, etc., associated with a door opening in flight apparently affected 17 of the accident pilots to such an extent that aircraft control was significantly degraded. This resulted in the pilots either stalling the aircraft, landing with the gear up, landing hard, inadvertently flying into the ground or an object, or losing control of the aircraft while attempting to close the door. In 11 of these 17 accidents, the pilot-in-command had over 500 hours total flying time.

"A pilot who is not mentally prepared for an unfamiliar situation, such as a door opening in flight, may take inappropriate actions to deal with the situation. The stress inherent in such emergencies could cause pilots to narrow their normal scanning pattern, resulting in failure to monitor critical flight parameters or to perform essential actions.

"Individuals are less susceptible to distraction-induced errors and erroneous decision-making if they are prepared for an emergency or unusual event by having a pre-determined plan of action. Guidance on the handling of open doors on take-off or during flight is not consistently provided to pilots during initial training, nor is such training required by regulation. The study and reference materials currently used by student pilots provide little discussion on this subject." The Board followed this comment with its recommendation regarding pilot initial and recurrent training. [*Editor's Note:* Pilot distraction has been identified as a cause of many accidents in the U.S. over the years. As a result, the U.S. Practical Test Standards (PTS) for pilot certification requires that applicants be trained and tested on their ability to safely handle an aircraft system or equipment malfunction such as a door opening in flight or other common distractions listed in the PTS. The question is how many pilots think about and review emergency procedures after they get their certificate.]

The Board concluded its recommendations with the following observation. "The flight characteristics of an aircraft with an open door vary by aircraft type; consequently, type-specific procedures may be required in order to land safely with an open door. Some manufacturers already provide specific procedures in their safety supplements; however, the pilots' primary reference document, the Aircraft Flight Manual (AFM), normally does not contain this type of information. . . " The Board then went

on to ask manufacturers to include this type of information in their flight manuals.

In summation, the Board's comments can be reduced to three simple comments. Pilots should be prepared for the possibility of a door opening at any time. Pilots should check that all doors are secured as part of their preflight check. And the final comment involves the first rule of aviation, pilots must always fly their aircraft.

U.S. Customs Service Reminders to Private Flyers

For those of you who plan to take a vacation outside the U.S. here are a few reminders from the U.S. Customs Service to make the trip easier.

Advance Notice of Arrival

All aircraft, before coming into any area from any place outside the United States, for security reasons, and in order to avoid the penalties applicable to aircraft, shall furnish a timely notice of intended arrival. This may be done either by or at the request of the commander of the aircraft through the FAA or other flight notification procedures or directly to the District Director or other Customs officer-in-charge at the nearest intended place of first landing in such area. Check the U.S. Customs' "Guide for Private Flyers" or your local Customs office for specific advance notice requirements.

Advance Notice Requirements

Your advance notice or notice of intended arrival to Customs must contain the following information:

1. Aircraft registration number
2. Name of aircraft commander
3. Number of U.S. citizen passengers
4. Number of alien passsengers
5. Place of last departure
6. Estimated time and location of crossing U.S. border/coastline
7. Name of U.S. airport of first landing
8. Estimated time of arrival

Private aircraft that are coming from a foreign place are required to furnish the notice of intended arrival in compliance with these special reporting requirements and must land for Customs processing at the nearest designated airport to the border or coastline crossing point unless an overflight exemption has been granted. Check with the Customs district office having jurisdiction over the airport you wish to fly to for overflight exemption application requirements.

Emergency Landings

Pilots should report as promptly as possible by telephone or most convenient means to the nearest Customs office. All merchandise and baggage should be kept in a segregated area. No passengers or crew should be permitted to depart the place of arrival or come in contact with the public without official permission, unless other action is necessary for the preservatio of life, health, or property.

Required Aircraft Documents for U.S. Customs Inspection

1. Aircraft registration
2. Pilot license
3. Medical certficate
4. Airworthiness certificate
5. FAA Form 337 (Major Repair and Alteration) on board for additional fuel tank installation in baggage/cargo compartments
6. Radio license

Other Reminders

- Overflight exemption and landing rights permissions if applicable
- Required survival equipment
- Current navigational charts
- Required insurance
- Proof of U.S. citizenship (current passport,original or notarized copy of birth certificate, voters registration card)
- If in possession of over $10,000 in monetary instruments, you must report to U.S. Customs the international movement of monetary instruments in excess if $10,000)
- Agricultural pests? (fruits, vegetables, plants, plant products, soil, meats, meat products, birds, snails, or other live animals or animal products)

This information is from a U.S. Customs handout. For your own copy of "Guide for Private Flyers," which lists all the airports serviced by the Service, write to U.S. Customs Service, P.O. Box 7407, Washington, DC 20044.

FAA Commissions First Precision Runway Monitor System

The FAA has just commissioned a new radar system at Raleigh-Durham International Airport, designed to enable simultaneous approaches to closely spaced parallel runways during low visibility weather. Called a precision runway monitor(PRM) system, it is the first of its kind to become operational in the United States.

The new radar system allows air traffic controllers to monitor aircraft making parallel approaches to runways during low visibility weather conditions. Equipped with electronically scanned radar and high resolution displays, it allows simultaneous landings on parallel runways, resulting in increased capacity, reduced delays, and fuel savings.

Roger Myers

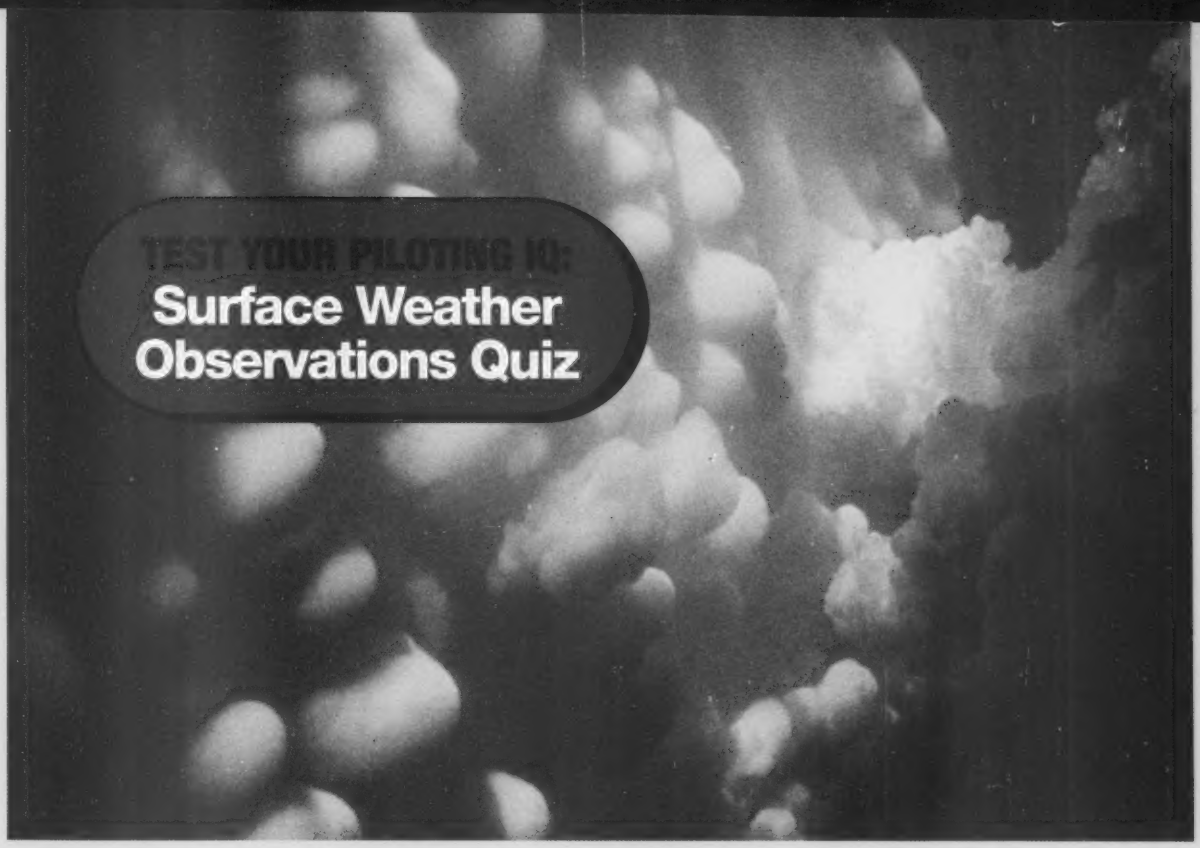
The precision runway monitor system enables landings on parallel runways as close as 3,400 feet apart. The parallel runways at Raleigh-Durham are 3,500 feet apart. Parallel runways operating without the benefit of the new radar system must be at least 4,300 feet apart for simultaneous landings in inclement weather.

The system scans a 360-degree area, providing air traffic controllers with a visual display of each aircraft's position, updating the information once per second. Automatic alerts—both visual and audio—are provided to assist controllers in assuring the required separation of traffic. The system also displays aircraft identification and position, along with a ten-second projected position of the aircraft.

Twenty-six of the top 100 airports have, or plan to have, parallel runways with spacings between 3,000 and 4,300 feet.

The precision runway monitor system will not only significantly increase airport capacity, but will maintain a high level of safety in aircraft operations. Costing about $6 million for each system, the FAA plans to install five of these new radar systems at airports around the country in the near future.

This article originally appeared in the FAA's Headquarters Intercom.



TEST YOUR PILOTING IQ: Surface Weather Observations Quiz

by Louise Oertly

In the September 1993 issue of *FAA Aviation News* Mr. Richard McDonald did an article entitled, "A Few Remarks About Surface Weather Observations." In this issue we are going to test your knowledge and see how many of these weather remarks you can translate. Match Column A with Column B. For the answers see page 3.

Column A

1. /FEW CU
2. /HIR CLDS VSB
3. /ACSL SW–NW
4. /CIG 14V19
5. /PRESRR
6. /F5 TWR VSBY 2
7. /TB08 S MOVG E OCNL LTGIC
8. /RADAT 87120
9. /BINOVC
10. /KOCTY
11. /VSBY NW½S2
12. /F BANK N–S
13. /TWRINUN
14. /WET SNW

Column B

____ A. Wet snow (snow that contains a great deal of water).

____ B. Control tower in unknown.

____ C. Obscuring phenomena at a distance. Fog bank north through south not at the weather station (airport).

____ D. When the visibility sector is less than 3 miles or when it is operationally significant and differs from the prevailing visibility, it is disseminated as a remark. In the example, visibility in the northwest was ½ mile, and in the south it was 2 miles.

____ E. Smoke over the city.

____ F. Breaks in the overcast not classified as thin.

____ G. Contraction for freezing level data (first two numbers indicate the relative humidity at the freezing level, the last three numbers indicate the height, MSL, in hundreds of feet of the freezing level. e.g., 12,000).

____ H. Thunder began eight minutes after the hour, the thunder (the sound of thunder) was south moving east with occasional lightning in the cloud where the thunder was heard.

____ I. Fog obscuring ⅝ of the sky, the control tower determined the surface visibility to be 2 miles.

____ J. Pressure rising rapidly (at a rate of 0.06 inch or more per hour, e.g., 29.92 to 29.86).

____ K. Ceiling variable 1400 to 1900 feet (used only when the ceiling is below 3000 feet).

____ L. Altocumulus standing lenticular clouds southwest through northwest.

____ M. Higher clouds visible through breaks in the overcast.

____ N. Few Cumulus (less than ⅛ covering the sky)

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